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April 4, 1911.

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POWER

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Index to Advertisers Follows Reading Matter

RHOADS
DRIVE BELTS

Tannate Belts

It outlasted all previous belts

No stretch

It seemed as good as new

Its cling

In August 1909 a 12-inch Tannate Double was put on a vertical drive where the best oak-tanned belts lasted from 12 to 18 months. It ran until January 1911, and that without a take-up. The belts they used before sometimes had to be shortened as often as once a week.

Then a fire caused them to change their drives, dispensing with this one. So they had us cut the belt into 6-inch widths. It came back looking as though it had not run more than a month. There was not a crack in the pulley side.

The surface was soft and clinging like an old razor strop,—no slipping on the pulleys for it! Suffice it to say that as 6-inch belts it now drives blowers.

Its uncommon toughness, flexibility and cling the Tannate owes to our method of tanning. Besides, it is tanned from specially selected hides.

Use Tannate for heavy drives. It gives greater strength and longer life with less weight of friction load.

Write for Record Tags, and keep records of our belts and others in comparison.

RECORD OF BELT

Machine
Brand of Belt
Length
Purchased from
Date put on
Dates taken up
Inches taken up
Cost of take up
REPAIRS
Dates
Material used
Labor cost
Loss from stops
Date taken off
Time of service
Total cost of take-up
Total cost of repairs
Cost per day
REMARKS

Width
Ply
(Single or Double turn)

J. E. RHOADS & SONS

J. E. RHOADS & SONS
PHILADELPHIA NEW YORK CHICAGO
FACTORY & TANNERY WILMINGTON, DEL.

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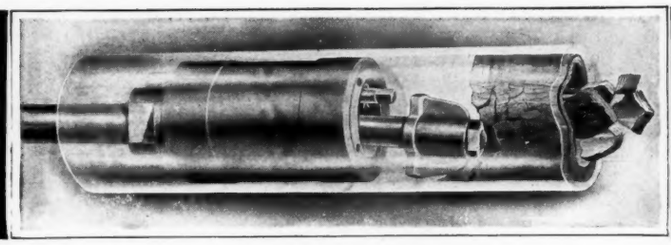

The Dean Removing Scale from the Tube of a Water Tube Boiler.

Show Me an Engineer Who Uses a Tube Cleaner and I'll Show You a Man Who is Producing Results

He may not have as easy a job as the engineer who physics his boilers with compounds and never introduces them to a tube cleaner.

But he'll have clean boilers, where the other fellow won't.

He'll have more to show in fuel savings, in boiler efficiency, in lessening repairs.

The engineering world today calls upon its workers to get out of the "compound rut" and use mechanical cleaners—because this is the age where results, and results only, count.

In the catalogue of the largest manufacturer of boilers you'll find these words: "———*though a rapid circulation of water will delay the deposit* [*of scale*], *and certain chemicals will change its character, yet the most certain cure is periodical inspection and mechanical cleaning.*"

These people speak for you—in your own interest.

The Dean Boiler Tube Cleaner

will do wonders for you in producing results.

An engineer—a compound user—tried a Dean because the Old Man told him to, and now he is getting along with 3 boilers where he previously used 4.

An engineer in Cleveland is saving $5.00 a week on coal because he uses a Dean.

A coal company paid $50.00 a month for compounds. They decided to try the Dean and they got an astonishing amount of scale out of the boilers. Now they use the Dean, have clean boilers, and don't pay a monthly tribute of $50.00.

These are some examples of Dean results.

Don't you want to try a Dean yourself? We'll loan you one for free trial.

The Wm. B. Pierce Company

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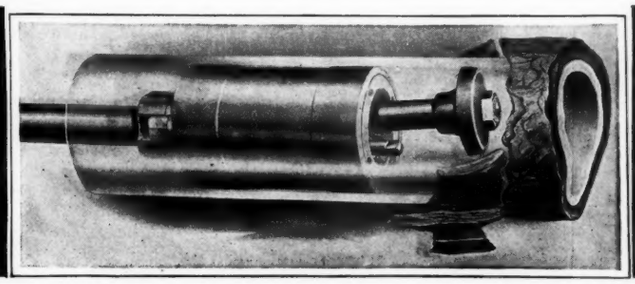
Jewett Building, Buffalo, N. Y.



The Dean Removing Scale from the Tube of a Return Tubular Boiler.

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POWER

NEW YORK, APRIL 4, 1911

THE watch engineer was making his tour of duty. Day after day, month after month, he had gone the rounds of engine stops, receivers, traps, etc., and everything was always found in good working order. Little whisperings at times urged the watch engineer to skip things here and there which, of course, were all right (?). Tonight the whisperings said the engine stops were all right. It was a winter evening and the peak load would be on in a few moments, and there were many little things to do to prepare for it. Why not let the nonessentials slide? Old No. 5 wouldn't run away—not under the load that was coming. But the watch engineer was obdurate. Every little thing must be done. There should be no slighting of the smallest detail.

The stops were of the type that closes the throttle valve. The stop of No. 5 tripped all right, but there was something queer about it. Instead of running down, the valve hung still and the engineer's hand caught a vibration of the wheel as though the stem were dancing up and down. The fact was that the throttle was open less than a turn. On the light load it had not been noticed. Had it not been found out, a "down-and-out" would have been registered against the station.

Another engineer, of another sort, relieved Dave that night before No. 5 went down. When the switchboard man interrupted him in the midst of the closing scenes of "The Great Diamond Robbery," he reluctantly tossed the paper down and went over and closed the throttle of the big engine. He glanced over No. 2, which would run till morning, saw that the oiler was at work, then went over and lay down on the big broad belt of No. 4. No. 5 would be needed for the morning load, but the only preparation she got was the little wiping the oiler gave her.

At five o'clock in the morning steam was turned on again and—snap, bang—the low-pressure rocker arm had broken off. The station got a black mark that time, of course, for part of the load had to be dropped—and the cause? Well, they found the wrist-plate had run hot, and when she shut down, it "froze." After several attempts to free it, the stud was removed from the cylinder and the whole thing sent to the shop, where 14 tons pressure was required to pull the wrist-plate from the stud.

A month later, the watches had been shifted. Dave was now on the night run. His program was of another sort. While the big engine was slowing down he felt each bearing. The moment she stopped he was at her with wrenches. Wedge bolts, keys, set screws and lock nuts were all gone over and the oil pipes examined.

As he was trying the lock nut on the low-pressure crank-pin oiler, his sharp eye discovered something wrong. It was another little thing, a tiny little thing—but so important. In the oilers on this engine there were holes opposite the center of the crank pin through which a wire might be inserted for the purpose of cleaning. Tiny plugs screwed into these holes. If a plug worked out, the oil would decorate the crank case instead of lubricating the crank pin—and trouble was not far ahead. And this was just what Dave had noticed. The plug was missing. A search light was brought to the scene, and after a short hunt the plug was found. No black mark that morning. But suppose the other fellow had been on the job!

It is a little thing to go over the wedge bolts and set screws every day, but it will often save you a shut-down and a black eye.

How many engineers, when it comes to regularly feeling the bearings of their engines, "let George do it"? And how many of those who regularly go over their engines every hour or every half hour, shut the throttles and leave the engines, not knowing what has happened to the bearings in the last half hour? It is a little thing, but do it. Go over the engine after you shut it down. It may help you to start up.

Power Plant of C. & N.W. Ry. Terminal

By Osborn Monnett

First new plant which has installed low-pressure turbine in connection with engine units. Special arrangement of boiler settings for heavy overloads. Piping connections of heating system of unusual interest.

One of the most important real-estate improvements made in Chicago in late years is that of the new terminal station of the Chicago & Northwestern Railway, with passenger entrance fronting on West Madison street, from Canal to Clinton street. The property extends north to the junction of Clinton and Milwaukee avenue, the elevated tracks admitting street traffic underneath the structure and also permitting entrance to the Washington street tunnel, which has lately been reconstructed. The power house to light, heat, ventilate and is other ways serve the public at this station, occupies a triangular shape of land between Lake street, Clinton street and Milwaukee avenue, and is an ingenious utilization of an area which would ordinarily be useless. The plant has been laid out with special reference to the unusual ground-plan conditions, with the stack occupying the apex of the triangle and the arrangement has been such as to secure all necessary room for the desired purposes. Pressed brick on the inside walls, set off with a green Rockwood tile wainscoting around the visitors' gallery and the engine room and in the engineer's office, adds greatly to the appearance of the station and gives the impression of attention to detail which is characteristic of the entire work.

In the boiler room are six 500-horsepower Babcock & Wilcox boilers, the type of setting being similar to that lately used in one other of the large plants around Chicago, and specially designed to permit forcing the boiler to heavy overloads. They are, as will be noted in the drawings, of the vertical-header type, with three gas passes through the tubes and are set in the reverse position to that ordinarily followed, with the chain-grate stokers under the mud drum. This gives large combustion space wherein the products of combustion may mix, and the setting has been unusually successful from the standpoint of eliminating smoke. Directly over the stoker arches, which are protected by water-tight sheet-iron pans, three blowoff connections are brought off to the side of the stoker, as shown in the photograph of the boiler room. These are easily manipulated by

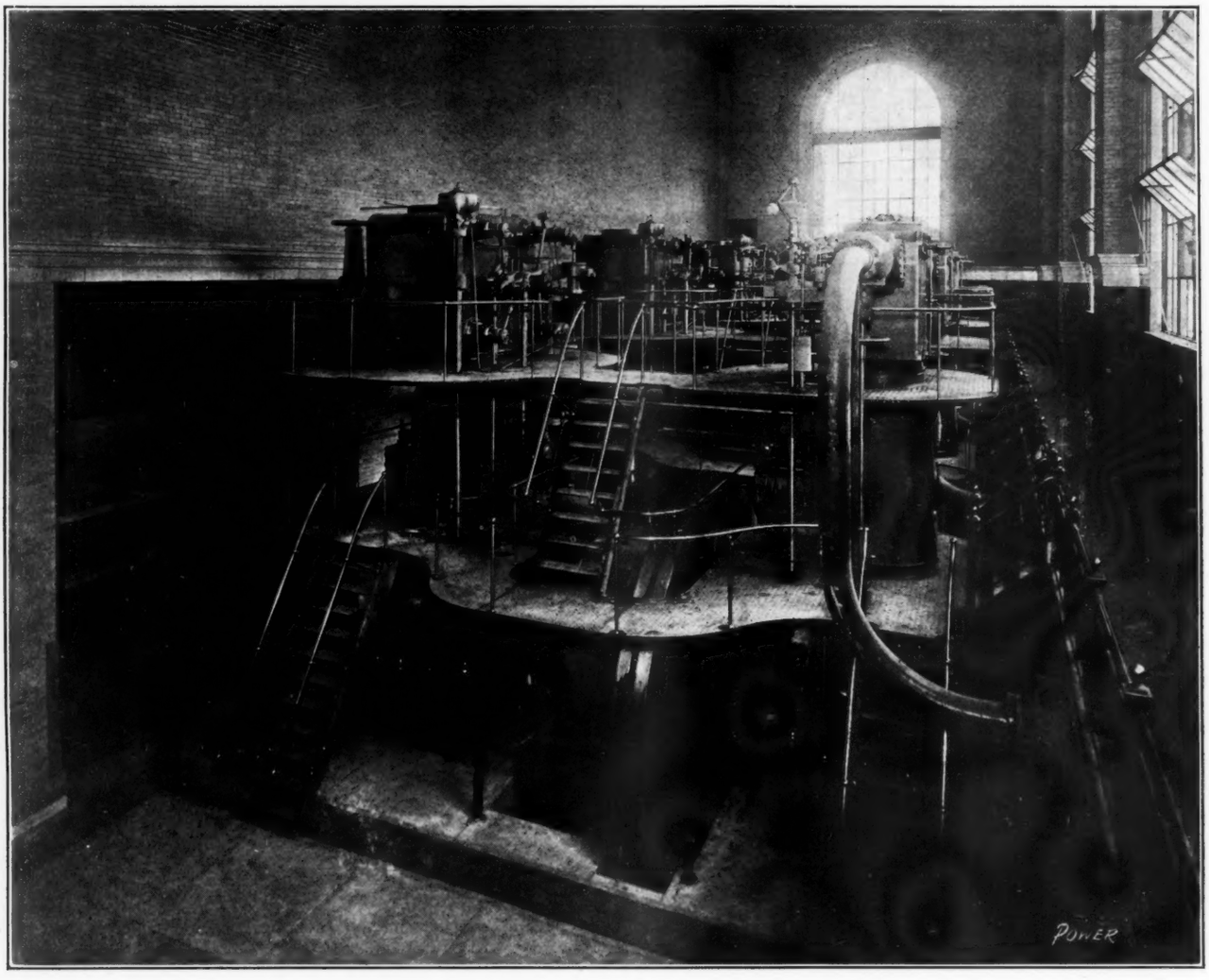


FIG. 1. GENERAL VIEW OF MAIN ENGINE UNITS

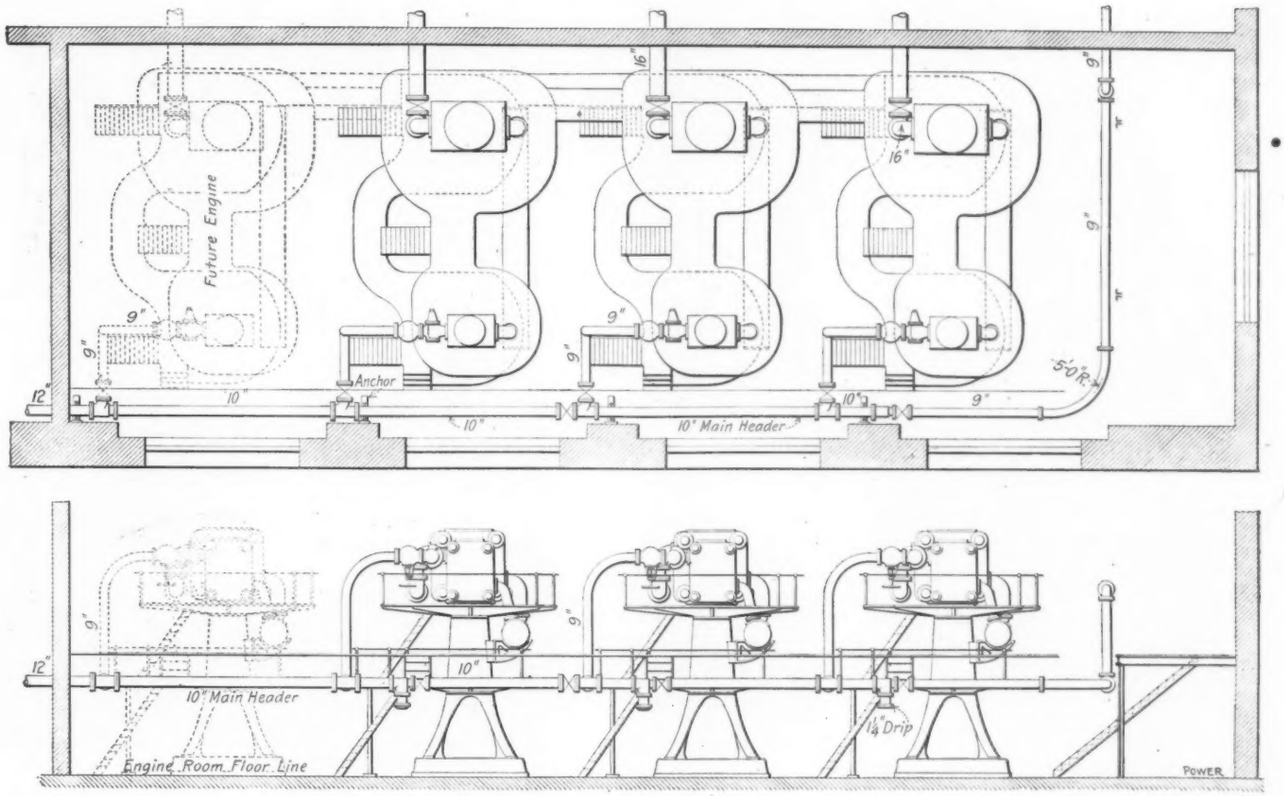


FIG. 2. PIPING CONNECTIONS IN ENGINE ROOM

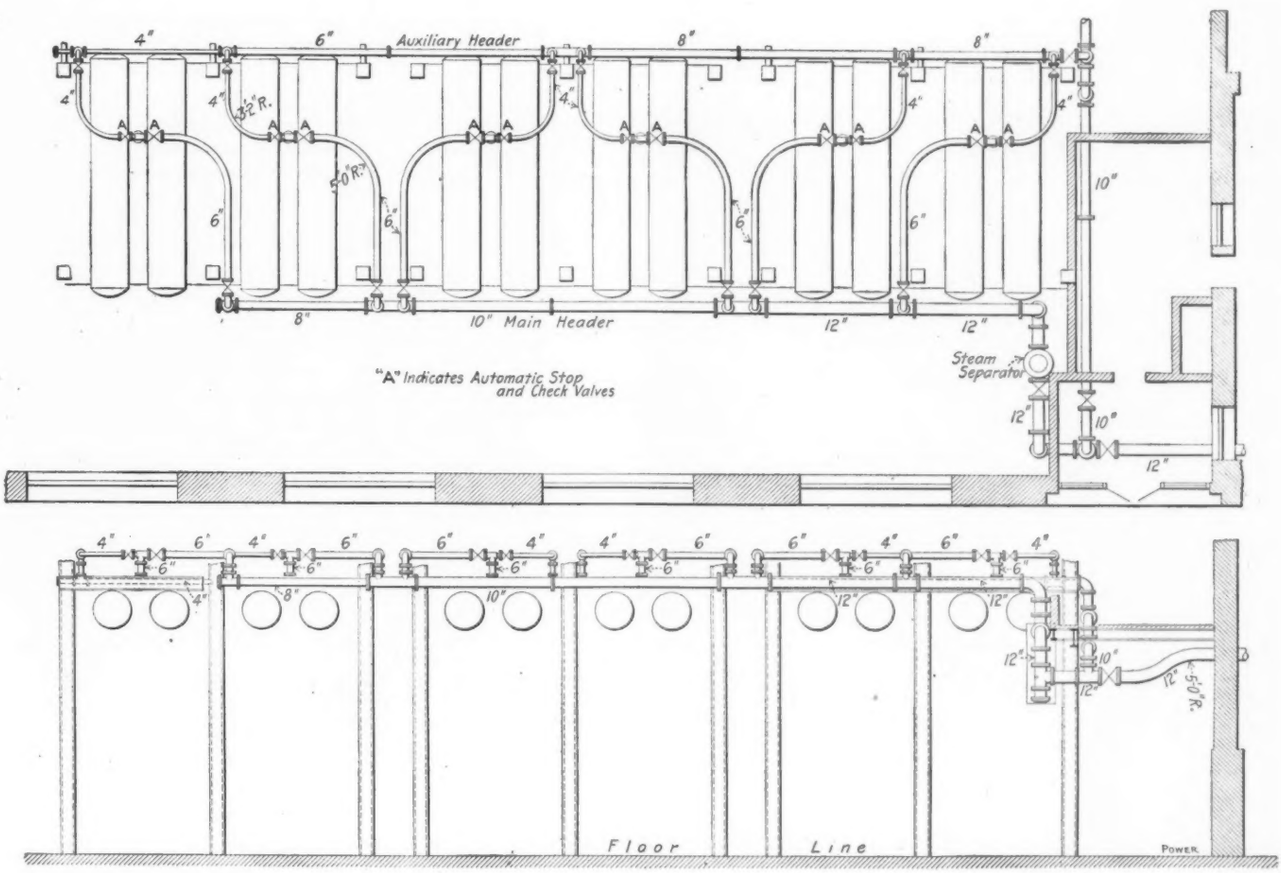


FIG. 3. PLAN AND ELEVATION OF BOILER PIPING

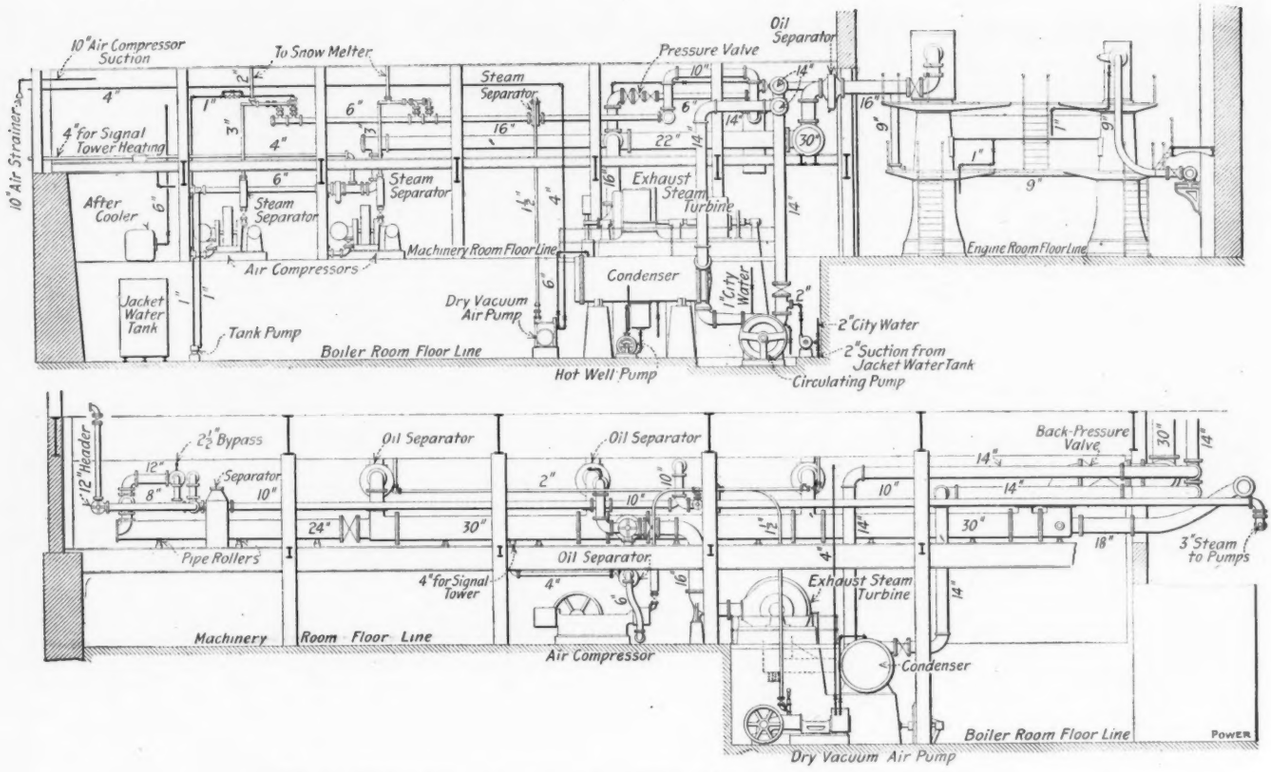


FIG. 4. SECTIONAL ELEVATIONS THROUGH ENGINE AND MACHINERY ROOMS

the fireman, who is not required to go behind the boilers for any purpose, the feed valve also being conveniently located at this point. Every detail in the boiler setting has been worked out for the greatest efficiency. Vulcan soot blowers are installed for keeping the heating surfaces clean, and if desired it is possible to run the boilers at 75 to 100 per cent. above rating, or approximately 800 to 1000 horsepower per boiler.

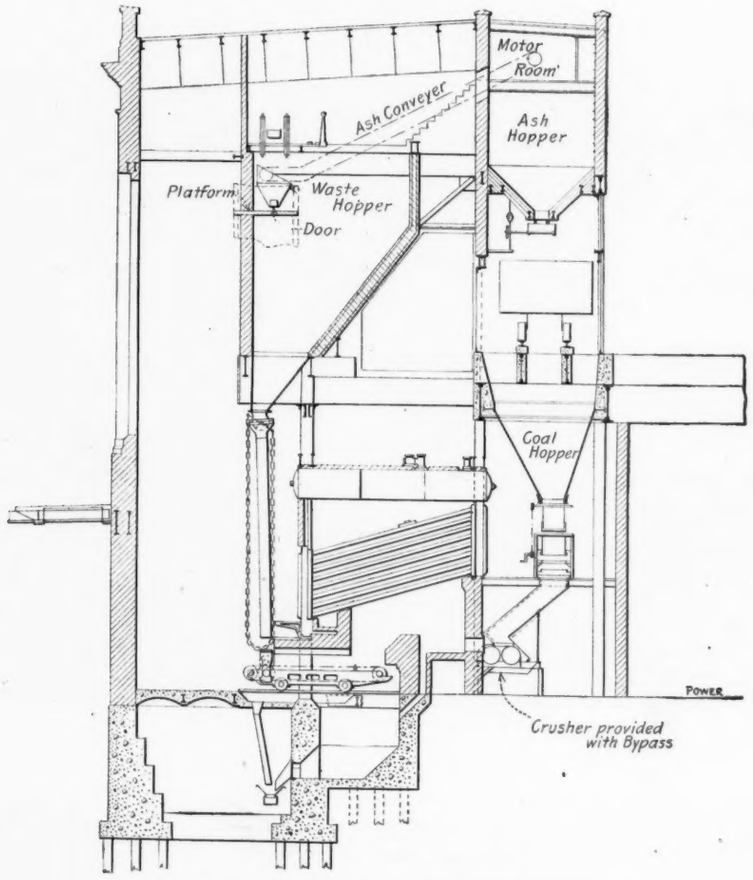


FIG. 5. TRANSVERSE SECTION THROUGH BOILER ROOM

Coal- and ash-handling apparatus has been so designed as to handle coal in carload lots from the track elevation. The unloading hopper has a capacity of 300 to 400 tons and a length which will permit two cars being unloaded at one time. From the bunker underneath the tracks the coal passes on to a horizontal conveyer, through a crusher into a Peck, continuous, pivoted, bucket conveyer, which elevates it to concrete bunkers over the boilers, the latter having a capacity of 750 tons without trimming or 1000 tons if trimmed.

Ashes are discharged from the grates into hoppers below the boiler-room floor line and carried by the same conveyer which transports the coal, to an inclined pan conveyer discharging into an ash bunker located above the coaling track and capable of holding 100 tons of ashes. The unloading arrangement has a rated capacity of 40 tons per hour.

Although the type of boiler setting chosen necessitates extremely high headroom, still there is plenty of space provided for convenient operation and the boiler plant is unusually light and roomy. Auxiliary storage capacity of approximately 300 tons of coal is provided under the sidewalk on the Canal street side, immediately in front of the boilers. This storage space is liberally supplied with sidewalk lights, while the boiler-room floor itself between the boiler settings is

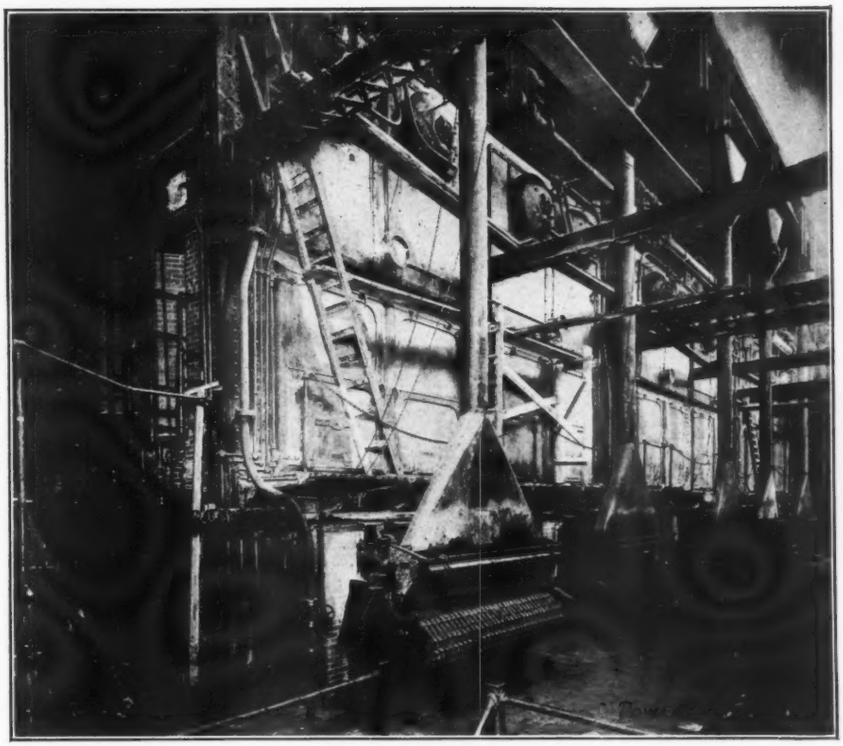


FIG. 6. THE BOILER ROOM

also fitted in this manner, lighting up the ash tunnel. A feature worthy of note is the special means of taking care of expansion in the boiler breeching. This is supported on saddles and springs resting on the building I-beams and allows for free movement with varying temperatures. The breeching is covered with 2 inches of vitribestos and the method of suspension insures that no leaks or cracks will develop in its structure. Passing to the stack, which is of Custodis construction, 11 feet in internal diameter at the base and 10 feet 6 inches at the top, the gases are discharged 225 feet above grade or 247 feet above the boiler-room floor line.

FIG. 7. POWER HOUSE OF NORTHWESTERN TERMINAL

One of the unusual features in the design of the plant is the convenient location of the engineer's office. This is at the grade line, with the entrance on Clinton street, and is located between the boiler and engine rooms with windows on each side so that both departments are visible from this central point. In case of trouble in any part of the plant the point can be

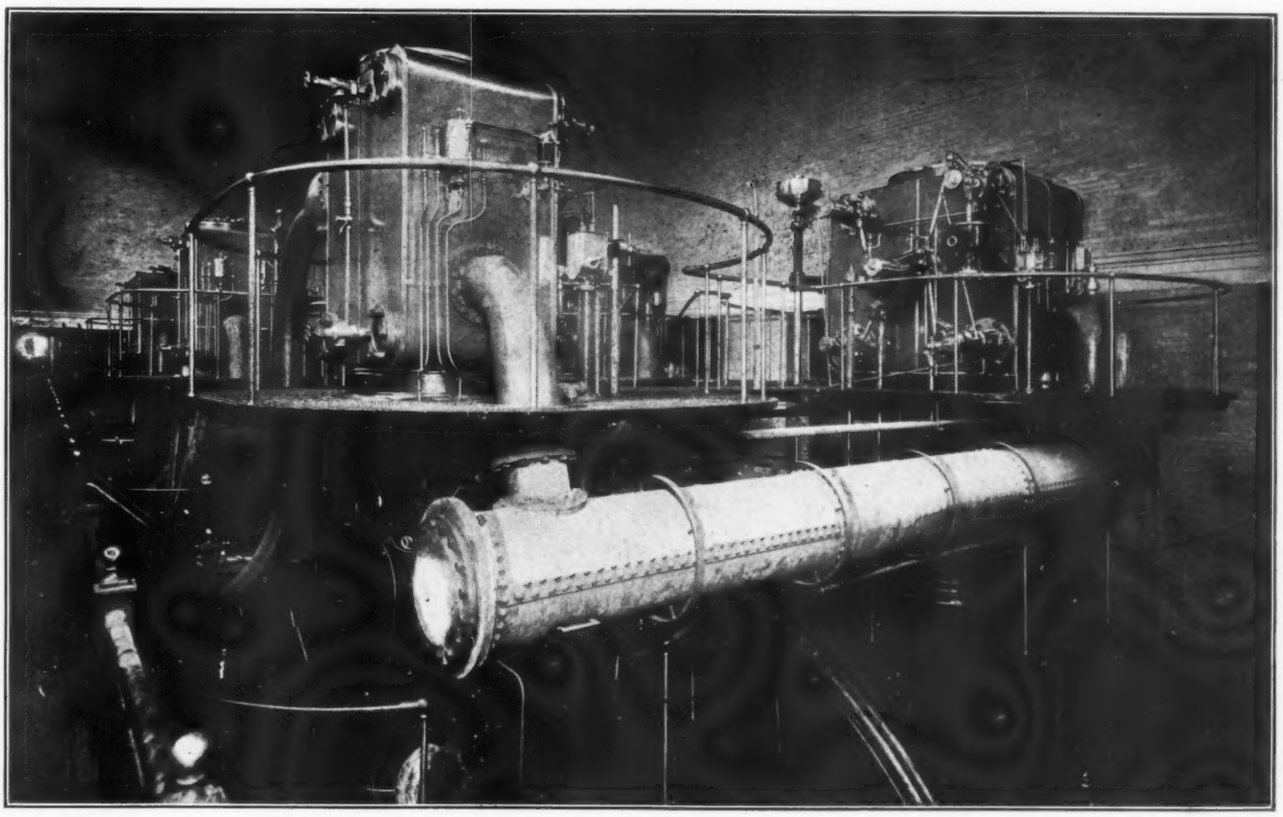


FIG. 8. VIEW OF ENGINE CYLINDERS FROM GALLERY LEVEL

conveniently reached from the engineer's headquarters in the shortest possible time. This central division of the power house continues to the roof so that both engine and boiler rooms can be entered at any level by means of stairways conveniently located. A gage board is located here with all the usual instruments for checking operation.

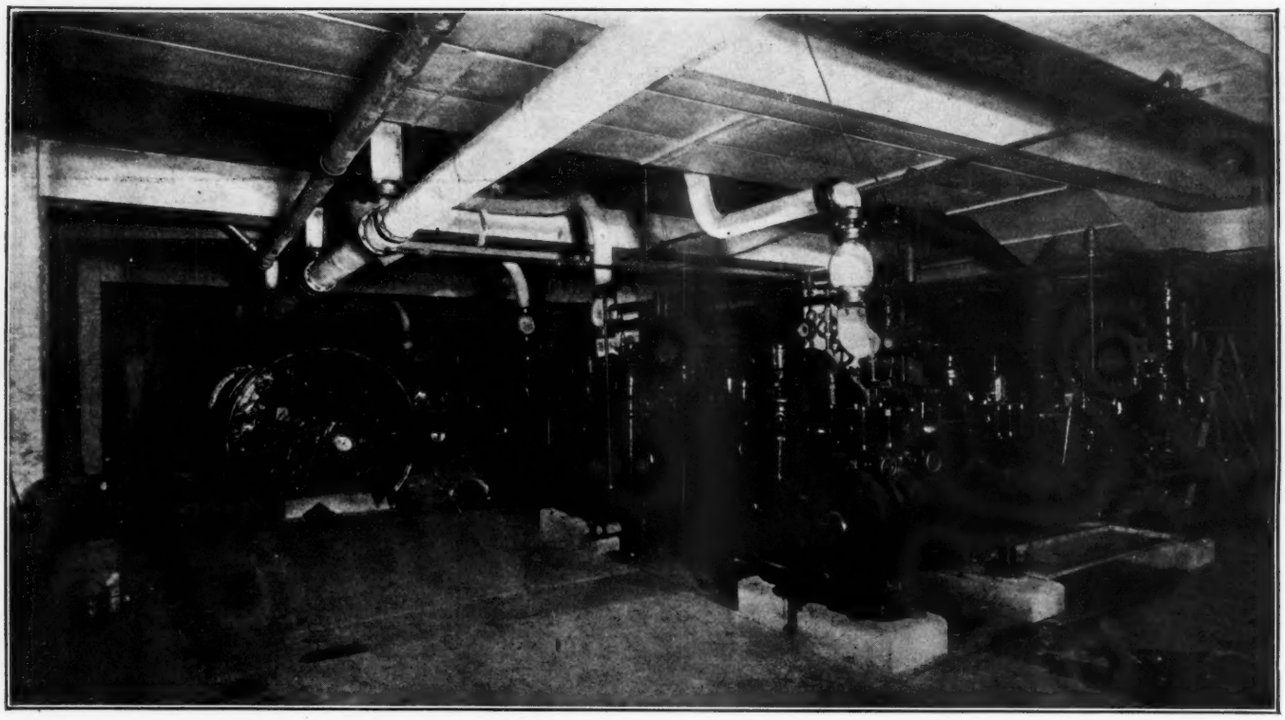


FIG. 9. ELEVATOR PUMPS UNDER MADISON STREET END OF STATION

In the engine room there are at present installed three vertical cross-compound noncondensing Allis-Chalmers Corliss engines, with 25 and 44 by 42-inch cylinders, each rated at 1150 indicated horsepower, at 100 revolutions per minute, with steam pressure at 155 pounds and 60 degrees, Fahrenheit, superheat. Space has been left for an additional engine and dynamo unit of the same size as above. The engine platforms are all interconnecting and arranged for maximum convenience of the operators. One Curtis low-pressure steam turbine and generator unit of 500 kilowatts capacity is installed in the machine room. It is the intention to run noncondensing during seasons when steam for heating will be necessary and use the low-pressure turbine only at such times as exhaust steam would ordinarily be allowed to waste to the atmosphere. When not running on the heating system the light loads will be taken care of by one of the Corliss engines and as the load increases beyond the capacity of one engine unit it will be thrown on to the low-pressure turbine up to a point where the combined units are fully loaded, when another engine outfit will be cut in and so on. The engine sets are guaranteed to run on 18.6 pounds of steam per indicated horsepower at full load, against 16.5 pounds absolute back pressure. This will mean 21,400 pounds of steam exhausted to the low-pressure turbine. The latter has been installed under a guarantee to deliver a kilowatt-hour on 43.5 pounds of exhaust steam, or a horsepower-hour on 32.7 pounds. Using the 21,400 pounds of steam exhausted from the engine unit, the low-pressure machine will develop an additional 786 horsepower, making a total of 1936 horsepower for the combined outfit, on 21,400 pounds of steam, or a horsepower-hour on 11.8 pounds of steam.

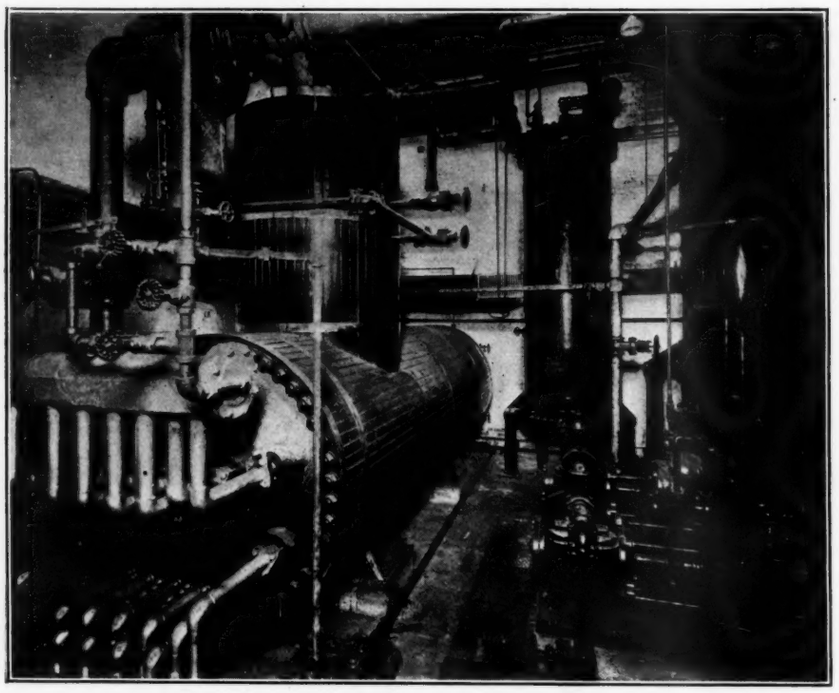


FIG. 10. ABSORPTION REFRIGERATING SYSTEM

Under present conditions it is possible to operate the turbine for eight months in the year and if plans under consideration go through, the turbine will be used the year round.

As far as the writer is aware, this is the first time an exhaust-steam turbine, installed in connection with engine units, has been included in the original layout.

FIG. 11. ENGINEER'S OFFICE AT POWER HOUSE

This, of course, is largely due to the newness of this type of machine in this country. The reduction in steam consumption per horsepower-hour developed in this particular installation is considerable, and besides it would be difficult to devise a more flexible system for utilizing to the best advantage the supply of exhaust steam.

The connection of the turbine to the exhaust piping of the plant is clearly shown in Fig. 4, which shows sectional views running through the engine and machinery rooms. From these views it may be seen that it is possible to use in the low-pressure turbine the exhaust steam from the auxiliaries as well as from the main engine units.

There are already installed in the machine room, two 500-kilowatt motor-generator sets, which will be used to convert the 250-volt, direct-current, generated in the plant, to 6600-volt three-phase 60-cycle currents for lighting service along the Northwestern line inside the city limits. This current will be used for the entire switch and signal system and lighting the Chicago terminal, subways, freight houses, yards, etc.

When running condensing the exhaust from the turbine is discharged into a Worthington surface condenser with 4000 square feet of cooling surface, guaranteed to hold a vacuum within 3 inches of absolute when condensing 23,000 pounds of steam per hour, with circulating water at 75 degrees Fahrenheit. In connection with this condensing outfit a cooling tower has been installed on the roof. This tower will cool the necessary amount of condensing water when the atmospheric temperature is 75 degrees Fahrenheit with relative humidity of 70 per cent. The tower is of the four-fan type, the fans being driven by two 25-horsepower motors. All jacket water

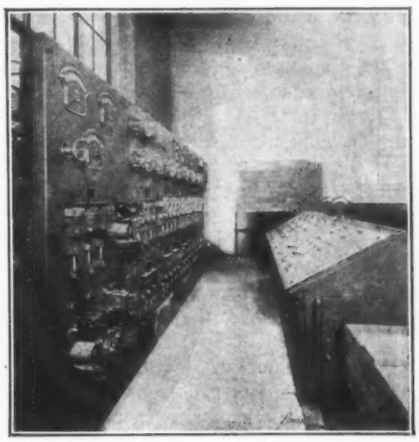


FIG. 12. SWITCHBOARD

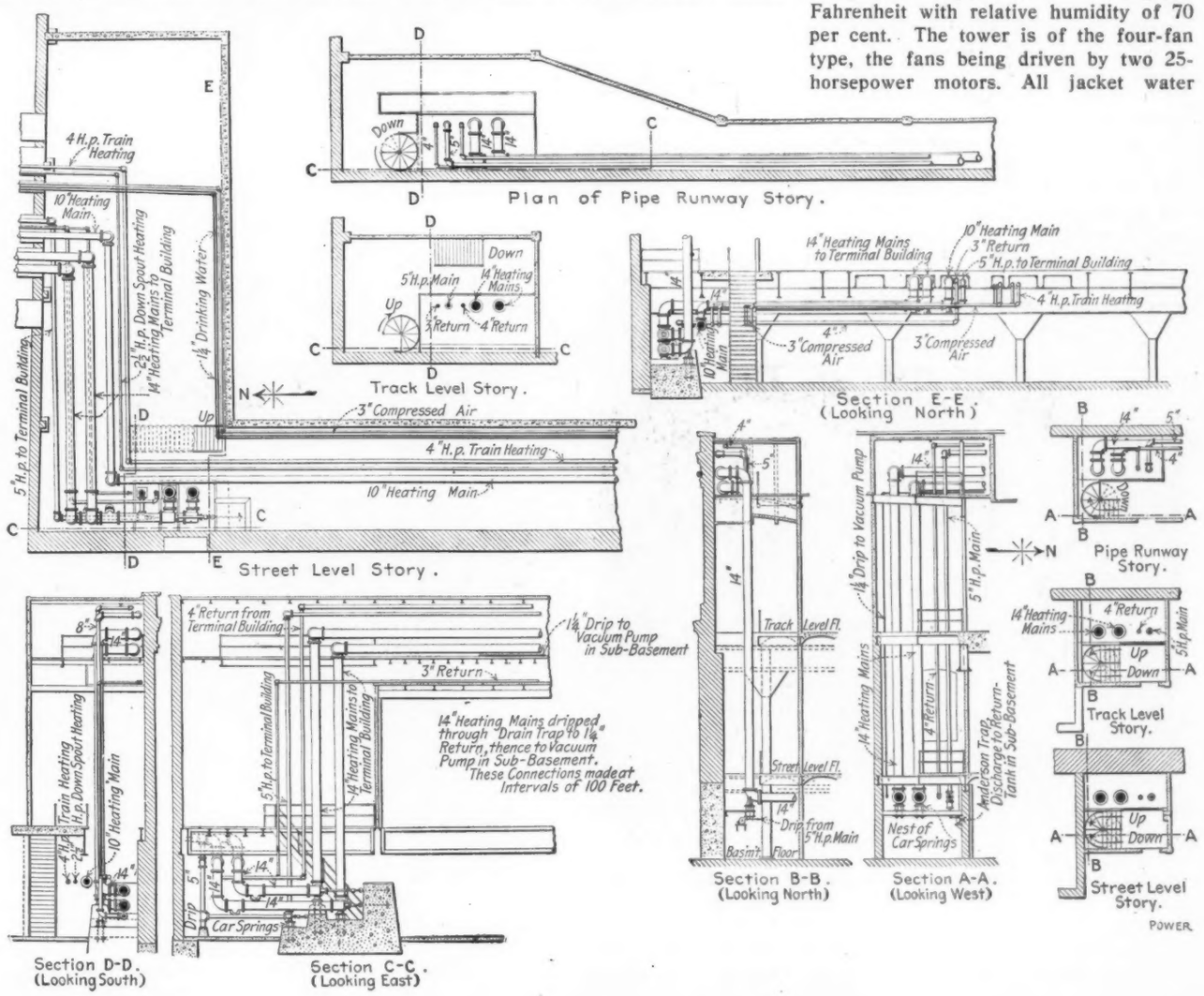

Plan of Pipe Runway Story.
Track Level Story.
Street Level Story.
Section E-E. (Looking North)
Section B-B. (Looking North)
Section A-A. (Looking West)
Section D-D. (Looking South)
Section C-C. (Looking East)
Pipe Runway Story.
Track Level Story.
Street Level Story.
4 H.p. Train Heating
10" Heating Main
2½" H.p. Down Spout Heating
14" Heating Mains to Terminal Building
¼" Drinking Water
5" H.p. to Terminal Building
3" Compressed Air
4" H.p. Train Heating
10" Heating Main
5" H.p. Main
14" Heating Mains
3" Return
4" Return
14" Heating Mains to Terminal Building
10" Heating Main
3" Return
5" H.p. to Terminal Building
4" H.p. Train Heating
4" Return from Terminal Building
¼" Drip to Vacuum Pump in Sub-Basement
14" Heating Mains dripped through "Drain Trap to 1¼" Return, thence to Vacuum Pump in Sub-Basement. These Connections made at Intervals of 100 Feet.
¼" Drip to Vacuum Pump
Track Level Fl.
Street Level Fl.
Drip from 5" H.p. Main
Basin't Floor
Nest of Car Springs
Anderson Trap. Discharge to Return-Tank in Sub-Basement
Car Springs
Drip
POWER

FIG. 13. DETAILS OF SYSTEM DESIGNED TO HEAT TERMINAL

from the air compressors, main engine journals, aftercoolers, etc., is collected in a tank from which a small centrifugal pump furnishes the make-up water for the cooling tower. In this way water which is supplied from the city mains is economized.

In the south end of the engine room on the balcony are located the switchboard and benchboard for controlling the electrical units. The operator stands facing the machines and makes all connections by means of remote-control switches. A busbar tunnel runs under the engine-room floor, with circuit breakers on the generator leads. The generator rheostats are controlled by push-botton switches on the benchboard. The main buses in the busbar tunnel run to the distributing switchboard which is furnished with switches connected to circuits leading to the main building, outgoing lines, etc.

Unusual precautions have been taken to guard against breakdown in the piping system. From the steam nozzles the steam passes through 6-inch stop and check valves into the main header lying in front of the boilers at a level with the drums. This header, starting at 8 inches in diameter, increases to 10 inches and finally in the engine room to 12 inches, extends under the balcony and entirely around the engine room, where it meets a 10-inch auxiliary header and forms a loop so that steam can be supplied in either direction from the boilers. The auxiliary connection from the boilers starts at the boiler nozzles in a 4-inch connection, the auxiliary header behind the boilers being 6, 8 and 10 inches in diameter as shown on the piping layout. Superheated steam is used in all of the main and auxiliary piping. It is ger of turning superheated steam suddenly into a length of cold piping. Extending along one side of the engine room, as shown in the plan, is the 30-inch main exhaust header with an atmospheric relief run to a point above the roof. From this header a 16-inch connection leads to the low-pressure turbine. There is also a connection from the auxiliary header to the throttle of the low-pressure machine, enabling it to be supplied with live steam independent of the exhaust from the engine units. This makes it possible to generate 500 kilowatts of electricity and still shut down the entire system of main headers and low-pressure piping, other than the auxiliary header, for repair.

To act as an auxiliary on the heating and elevator load in the station building should a breakdown occur in the transmission piping from the main power house, a steam plant has been installed in the passenger-terminal building at Madison street. This consists of two 150-horse-power single-drum Babcock & Wilcox boilers fitted with Water-Arch hand-fired furnaces. All of the elevator-pumping equipment is installed in this end of the plant. There are in all thirteen hydraulic elevators in the passenger-terminal station, four for passengers and nine for

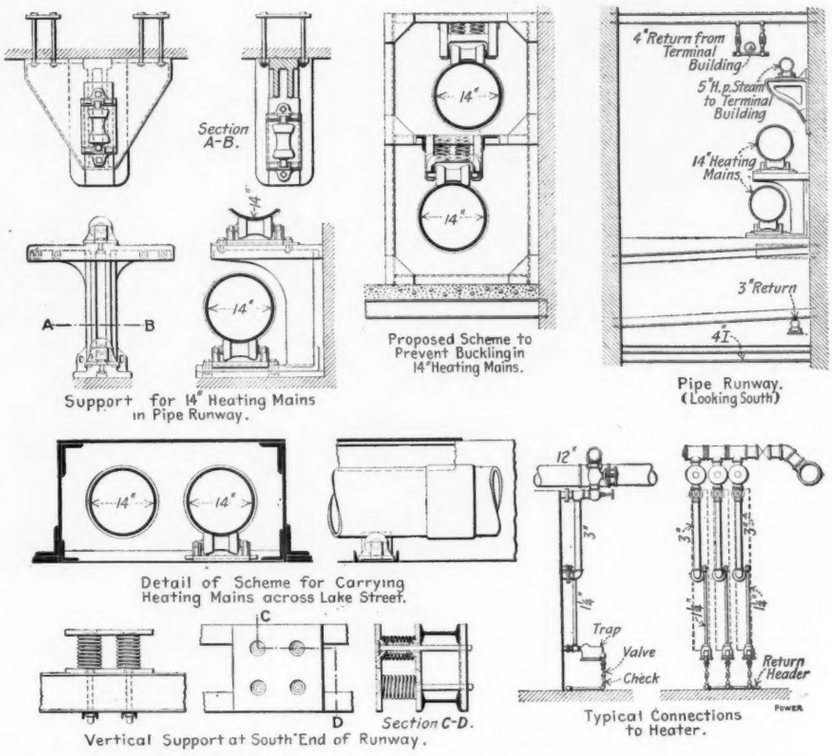


FIG. 16. SUPPORTS FOR HEATING MAINS AND TYPICAL CONNECTIONS TO HEATER

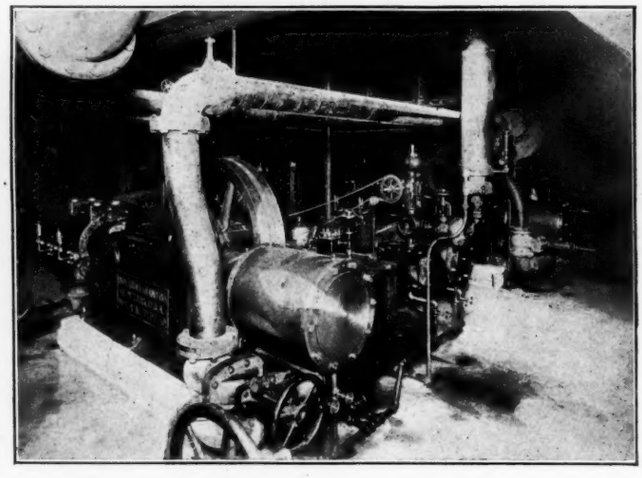


FIG. 14. AIR COMPRESSOR

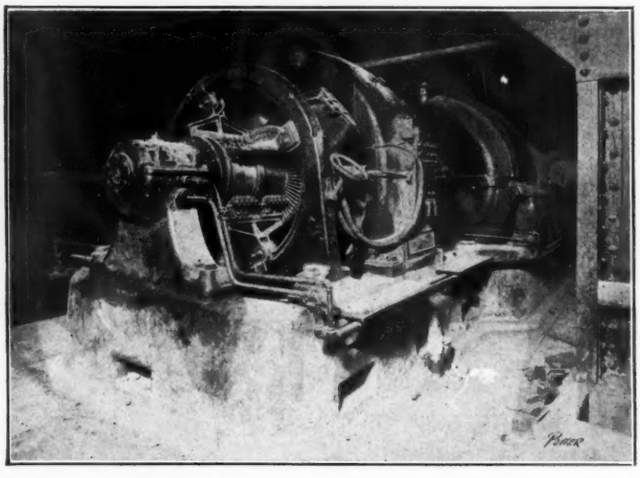


FIG. 15. LOW-PRESSURE TURBINE UNIT

baggage. They are all operated with water at 800 pounds per square inch. Two three-cylinder compound, crank-and-flywheel elevator pumps, and two tandem-compound pot-valve pumps take care of this service. In addition to this there are ten electric elevators for baggage, express and mail, and three dumb waiters with push-button control.

A complete Carbondale absorption refrigerating installation of 50 tons capacity is also located in the basement of the station for cooling drinking water and furnishing refrigeration for the various ice boxes in the restaurants and lunch rooms located throughout the building.

Of special interest is the heating and ventilating arrangement in the passenger station. This is done by the indirect blast system, except a small amount of direct radiation installed to take care of building losses. One of the largest air-heating plants ever installed in one chamber is located in the basement, having 25,000 square feet of Vento heaters, consisting of cast-iron elements taking steam from the low-pressure mains. All main supply ducts are in concrete tunnels carried beneath the floor line and the blast is supplied by electrically driven Sirrocco fans. Starting at the plenum or tempering chamber, galvanized-iron ducts distribute the heated air to the different portions of the building. The plenum chambers are centrally located and provided with automatically controlled dampers which temper the air delivered to the ducts. A complete system of exhaust ducts parallel the supply ducts throughout the building, with the exhaust fans located in the attic regulated by remote-control switches placed in the basement on the same operating board from which the corresponding supply-fan unit is controlled.

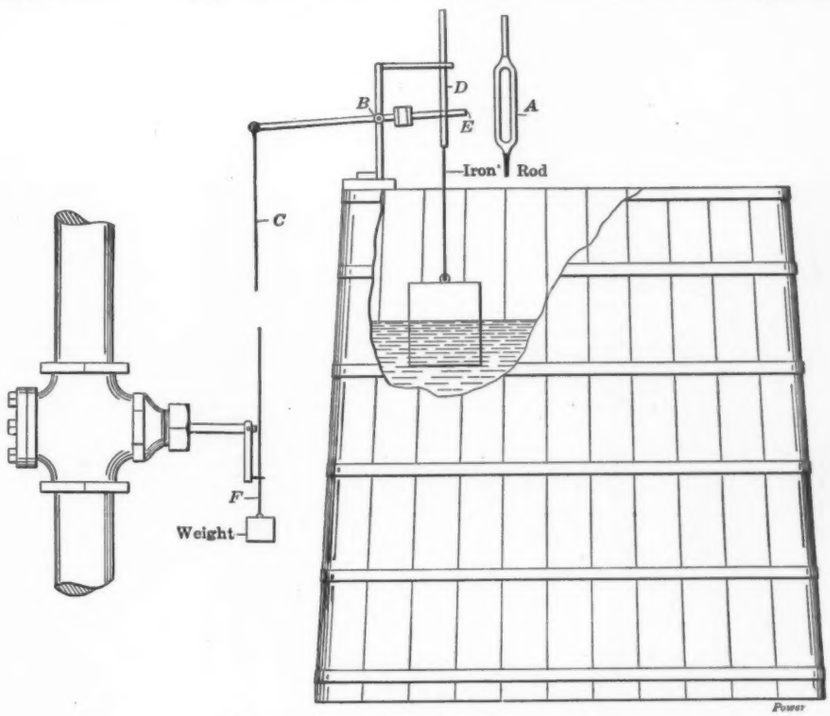
As the main and auxiliary plants are separated by no less than 1300 feet, some of the piping problems encountered are worthy of notice. There are two 14-inch exhaust-heating mains coming from the central plant; one 5-inch live-steam line for power; one 4-inch train-heating steam line, and one 3½-inch down-spout heating line. The 4- and 5-inch lines are fitted with automatic stop and check valves to automatically shut off the steam in case of accident. No expansion joints were used in the 14-inch lines, the expansion being taken up entirely by swing joints at either end as shown in the drawings. These lines are anchored at the center and expand both ways, being supported on special cast-iron brackets, allowing for the removal of any length of pipe without disturbing the bracket or the other piping. They are made up in sections of three lengths of pipe, fitted with extra-heavy screw couplings and at the end of each section with flange unions. The stretch of pipe between flanges constitutes a pipe unit and the presence of the flange unions three lengths apart permit a flexibility that would not otherwise be possible, as too many flanges would tend to stiffen the line and cause leaks. When steam is first applied to the lines they expand on top and the sections between the flanges raise from their supports until the pipe has been brought to a uniform temperature, and the condensation has been drawn out. The line then settles to its position on the brackets without shock or jar. In the design of the brackets it was arranged to bring the weight on the foot and relieve any stress on the side walls. It was calculated that there would be an expansion of 14 inches in the length of 1300 feet and in practice a movement of 14⅛ inches has been observed.

One of the special problems worked out in connection with the station was the method of keeping the horizontal runs of down-spout piping draining the roof of the train sheds from freezing in cold weather. The ordinary method of solving this problem is to let live steam blow into these spouts, which not only proves unsightly and wasteful, but also tends by condensing in the pipe, to increase the trouble from freezing. In this installation the horizontal runs are each fitted with a steam line laying immediately underneath the drain pipe and inside the lagging of same. This heating pipe is supplied with live steam at 40 pounds pressure throughout the entire train shed and has the effect of keeping the down-spouts entirely clear of frost in all weather and at the same time in the entire area underneath the train shed there is no steam escaping to the atmosphere. These heating lines are trapped, the condensation being discharged into the main heating system of the building. As this hot water is at 40 pounds pressure the effect of liberating it into the heating system at exhaust steam pressure is to cause it to flash into steam and it thus becomes useful for heating in the building after it has served its purpose in the down-spout system.

The steam and electrical work for this complete plant was designed by and erected under the supervision of Pierce, Richardson & Neiler, consulting engineers, Chicago. F. J. Ravlin, chief engineer of power stations for the Chicago & Northwestern Railway, is in direct charge of operation of the plant.

Unusual Float Control of Pump

In this instance the steam pipe supplying the pump is fitted with a quick opening valve, the valve stem of which is fitted with a lever instead of a hand-wheel, as shown in the accompanying illustration. To the top of the tank is securely fastened a rod which is bent at right angles and serves as a guide to the rod attached to the float. The float rod is slotted, as shown at *A*, and the slot limits the distance through which the water is allowed to fall before the steam valve is opened and the pump brought into operation. Pivoted to the supporting rod at *B* is a lever in one end of which a hole is drilled for the cord *C*. The cord extends over pulleys, conveniently arranged, down to the steam valve of the pump. The other end of this rod passes through the slot *A* of the float rod. From the sketch the operation will be apparent.



STEAM VALVE CONTROLLED BY FLOAT

Flow of Water in Clean Iron Pipes

By Albert E. Guy

Darcy's formula for the flow of water in pipes converted into United States units and applied to a convenient chart, whereby having given any two of the three quantities, gallons per minute, diameter of pipe and frictional head, the third can be read directly from the scale.

The chart herein given is based upon the work of Darcy, the well known hydraulic engineer who was assigned, by the French government the task of establishing a water system at Dijon in Burgundy. He found that the formulas in use at that time for determining the flow of water, the frictional loss of head and consequently the proper diameters of pipes, were very unsatisfactory; therefore, in order to bring about effective results with a minimum cost, he found it necessary to undertake new experiments from which, it was hoped, reliable data would be derived.

The experiments, numbering about one hundred and ninety-eight, were conducted on pipes made of various materials and sizes, these including pipes of drawn wrought iron, of lead, of iron coated inside with tar, of glass, of cast iron both new and clean, and also coated with deposits. The wrought-iron and cast-iron pipes were over 330 feet long; those of lead over 170 feet, and those of glass 146 feet. They were all well calibrated and the diameters were determined with extreme care. The lead pipes were about $\frac{9}{16}$, $\frac{13}{16}$ and $1\frac{5}{8}$ inches in diameter, and the wrought-iron and cast-iron pipes varied from ½ to 19¾ inches in diameter.

The quantity of water was measured in each case by means of calibrated tanks, and velocities as high as 19½ feet per second were used. The slopes of the pipes were carefully regulated so as to avoid all possible perturbations from elbows, abrupt changes of direction, or from air chambers sometimes formed through lack of care in assembling. The pressures at various points of the conduits were measured by means of piezometer tubes.

The thoroughness of the undertaking brought about splendid results, and these enabled Darcy to establish extensive tables which have proved very useful to engineers. The main points ascertained by Darcy were:

1. The friction of liquids is independent of the pressure.

2. The friction is proportional to the area of the surfaces in contact with the flowing liquid.

3. The condition of the surfaces of contact has a great influence on the friction.

Regarding the last point, he found that through the tar-coated and glass pipes, one-third more water was discharged than was indicated by the formula theretofore in use, and that deposits, even when forming but a very thin coating, caused an appreciable reduction in the amount discharged when no coating was present.

From the tables established, Darcy derived the following formula, which is known by his name:

$$hR = \left(a + \frac{\beta}{R}\right) u^2$$

in which,

R = Radius of pipe, in meters;
h = Frictional loss of head in fraction of a meter per meter of pipe length;
u = Velocity in meters per second;
$a = 0.000507$, $\beta = 0.00000647$ } constants for clean wrought-iron and cast-iron pipes;
$a = 0.001014$, $\beta = 0.000013$ } constants for slightly coated wrought-iron and cast-iron pipes.

It is usual to employ the values of the constants a and β given for clear pipes. They have been found very reliable under a great variety of conditions. It would be practically impossible to establish, even through careful experiments, a series of values for such constants, that would cover the various conditions of coated inside surfaces of pipes likely to be encountered in actual practice. Hence, it seems proper to use as a first approximation a formula established for clean pipes, and then, according to one's experience, to so modify the results obtained in the calculations as to finally be on the safe side. The formula has been used successfully for many years by the writer, and is recommended in the convenient form, shown hereafter. Transposed to English units this formula becomes,

$$1.27 \frac{D^3}{\sqrt{D+1}} \sqrt{h}$$

The transformation of the formula from the metric to United States measures is very easy. First,

$$hR = \left(a + \frac{\beta}{R}\right) u^2 \qquad (1)$$

which may be rearranged so that

$$u = \frac{R\sqrt{h}}{\sqrt{aR+\beta}} \qquad (2)$$

But if q is the volume in cubic meters discharged per second,

$$q = \pi R^2 u \qquad (3)$$

From (2) and (3),

$$u = \frac{q}{\pi R^2} = \frac{R\sqrt{h}}{\sqrt{aR+\beta}} \qquad (4)$$

whence,

$$q = \frac{\pi R^3 \sqrt{h}}{\sqrt{aR+\beta}} \qquad (5)$$

With the United States measures, q should be expressed in gallons per minute instead of cubic meters per second; the radius of the pipe in meters should be replaced by the diameter in inches; the frictional head h should be expressed in feet per 1000 feet of pipe length.

One cubic meter = 264.13 United States gallons.

One cubic meter per second = 15,848 gallons per minute.

One meter = 39.37 inches, and R (in meters) =

$$\frac{D \text{ (diameter in inches)}}{2 \times 39.37}$$

Equation (5) then becomes

$$\textit{Gallons per minute} = \frac{D^3 \times \sqrt{h} \times 15{,}848 \times \pi}{(2\times 39.37)^3 \times \sqrt{\dfrac{(0.000507 \times 2 \times 39.37 \times D) + 0.00000647 \times (2 \times 39.37)^2}{(2 \times 39.37)^2}}}$$

This reduces to

$$\textit{Gallons per minute} = \frac{40.152 \times D^3 \times \sqrt{h}}{\sqrt{D+1}}$$

But h is here expressed in meters per meter length of pipe; to express it in feet per 1000 feet of length, it must be written:

$$\textit{Gallons per minute} = \frac{40.152 \times D^3 \times \sqrt{h}}{\sqrt{(D+1)\times 1000}} = \frac{1.27 \times D^3 \times \sqrt{h}}{\sqrt{D+1}} \qquad (6)$$

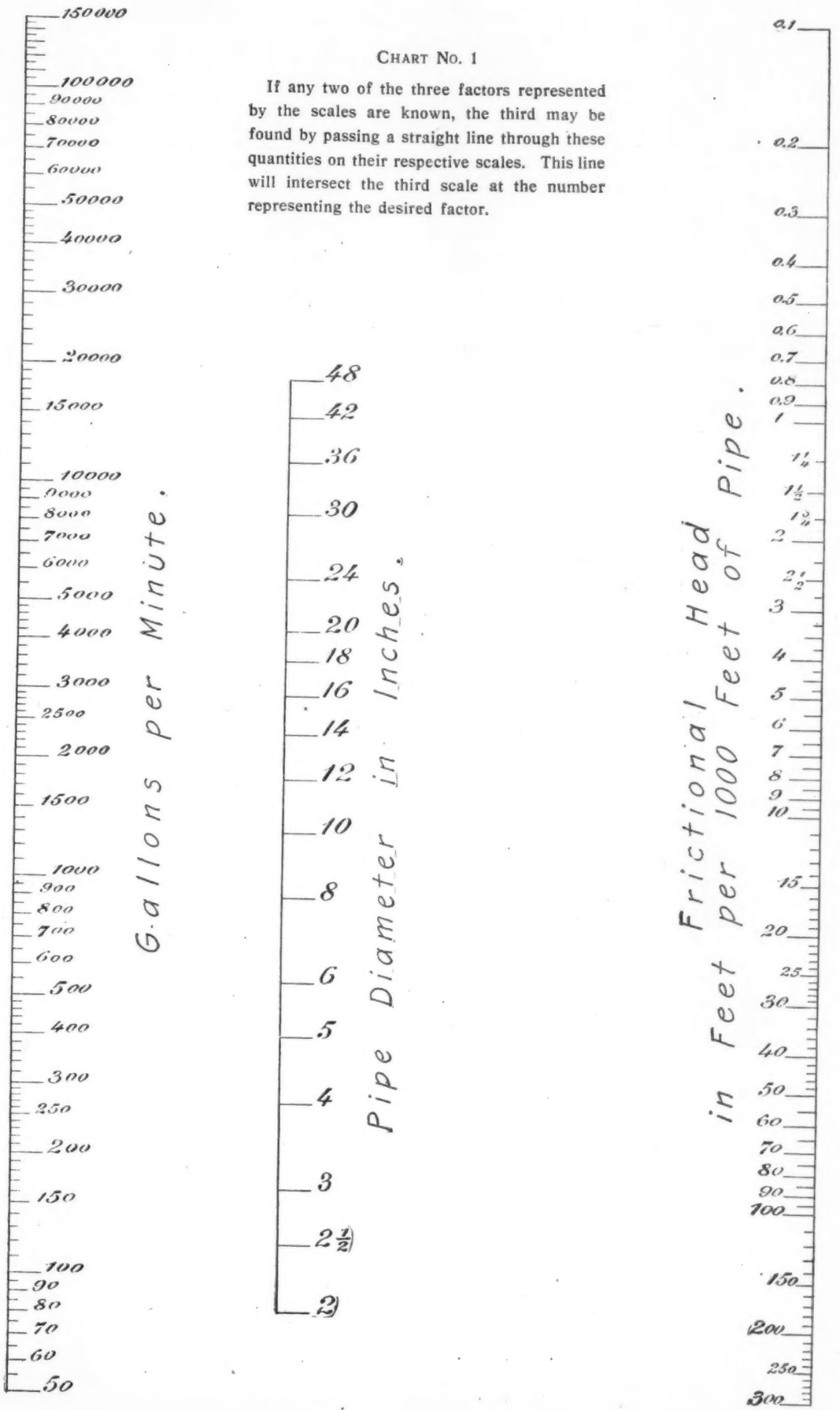
Another convenient form is

$$\textit{Gallons per minute} = \frac{D^3}{\sqrt{0.62\,(D+1)}} \times \sqrt{h} \qquad (7)$$

Chart No. 1 is intended for capacities between 50 and 150,000 gallons per minute, for pipes of 2 to 48 inches diameter, and for frictional losses of head varying from 0.1 foot to 300 feet per

CHART NO. 1

If any two of the three factors represented by the scales are known, the third may be found by passing a straight line through these quantities on their respective scales. This line will intersect the third scale at the number representing the desired factor.



thousand feet of length of pipe. The chart consists of three parallel scales, the first of which represents the gallons per minute; the second, the diameter of pipe in inches, and the third, the frictional head in feet. These scales are logarithmic and are so arranged that a straight line intersecting the three scales will show the result at a glance; for instance, 1600 gallons passing through an 8-inch pipe per minute will entail a loss of head of 54½ feet, for each 1000 feet of length of pipe. For a lesser or greater length, the loss will be proportional.

The lengths of the scales depend on how close the readings are desired. Sometimes it is found very convenient to make two or more charts to cover a certain range of values. The distance between the first and the last scales must be such that a diagonal line joining the extreme

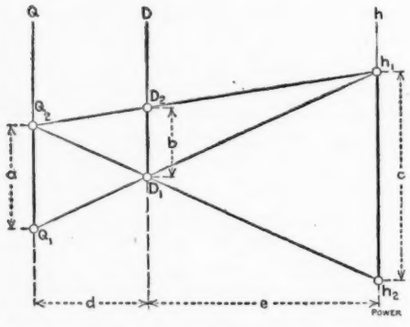


FIG. 1. SHOWING METHOD OF CONSTRUCTING CHART NO. 1.

values of these scales would lie at an angle not much less than 45 degrees; if the angle were 20 degrees, for instance, it would be difficult to estimate correctly the readings.

The problem in making the chart is first to determine the relative positions of the scales and the "modulus" proper to each. By modulus is meant the length in inches, or more usually in millimeters, of a logarithmic scale ranging from 1 to 10. Neglecting, for the present, the denominator in equation (7), that is, considering it as a constant to be introduced later on, there remains:

$$Gallons\ per\ minute = D^3 \sqrt{h} \qquad (8)$$

Let the gallons per minute be represented by Q (for quantity) and Fig. 1 the chart to be established. The straight *lines* $Q_1 h_1$, $Q_2 h_2$ and $Q_2 h_1$ are drawn through the three scales, $Q_1 h_1$ and $Q_2 h_1$ intersecting exactly at point h_1 on the third scale. Similarly $Q_2 h_1$ and $Q_2 h_2$ intersect exactly at point Q_2. This can be read as follows: For a quantity Q_1 passing through a pipe of diameter D_1, the frictional loss of head h_1 is precisely the same as for a quantity Q_2 traversing a pipe of diameter D_2. Also, a quantity Q_2 traversing a pipe of diameter D_2 will entail a loss of head equal to h_1, while in passing through a pipe of diameter D_1 the loss will be h_2 feet.

Let a, b and c be the distance in millimeters between the readings representing respectively the numbers Q_1 and Q_2, D_1 and D_2, h_1 and h_2. With m_1, m_2 and m_3, respectively, the modulus of the Q, D and h scales,

$$\left.\begin{aligned} a &= (log.\ Q_2 - log.\ Q_1)\ m_1 \\ b &= (log.\ D_2 - log.\ D_1)\ m_2 \\ c &= (log.\ h_2 - log.\ h_1)\ m_3 \end{aligned}\right\} \qquad (9)$$

The similar triangles, in Fig. 1, show

$$\frac{c}{b} = \frac{d+e}{d} \qquad (10)$$

$$\frac{a}{b} = \frac{d+e}{e} \qquad (11)$$

whence,

$$\frac{a}{c} = \frac{d}{e} \qquad (12)$$

Assuming the following values:
$Q_1 =$ 1,000 gallons per minute [log. = 3],
$Q_2 =$ 10,000 gallons per minute [log. = 4],
$D_2 =$ 30 inches [log. = 1.4771213],
by equation (8)

$h_1 = 0.13717$ [log. = $\bar{1}$.1372722]
$h_2 = 13.717$ [log. = 1.1372722]
$D_1 = 13.925$ [log. = 1.1437879]

Replacing a and c in equation (12) by their values,

$$\frac{(log.\ Q_2 - log.\ Q_1)\ m_1}{(log.\ h_2 - log.\ h_1)\ m_2} =$$

$$\frac{(4-3)\ m_1}{(\bar{1}.1372722 - \bar{1}.1372722)\ m_2} = \frac{m_1}{2\ m_2} = \frac{d}{e}$$

The quotient of the extreme values on scale Q and scale h_1 being the same, that is,

$$\frac{150{,}000}{50} = \frac{300}{0.1} = 3000$$

it follows that, other things considered, these scales can be made of equal length, and the same modulus can be adopted for the two. Then $m_1 = m_2$, and $e = 2d$.

From equation (9) and (10)

$$\frac{b}{c} = \frac{d}{d+e} = \frac{(log.\ D_2 - log.\ D_1)\ m_2}{(log.\ h_2 - log.\ h_1)\ m_3}$$

or,

$$\frac{d}{d+e} = \frac{1.4771213 - 1.1437879}{2} \times \frac{m_2}{m_3} =$$

$$\frac{0.3333\ m_2}{2\ m_3} = \frac{1}{6}\frac{m_2}{m_3}$$

but $e = 2d$, and

$$\frac{d}{d+e} = \frac{d}{d+2d} = \frac{1}{3}$$

then

$$\frac{1}{3} = \frac{1}{6}\frac{m_2}{m_3}$$

and

$$m_2 = 2\ m_3$$

The proportion between all the elements of the three scales are now established and there remains only to select the moduli most convenient for laying out the scales. Since,

$$\frac{150{,}000}{50} = \frac{300}{0.1} = 3000$$

$$log.\ 150{,}000 - log.\ 50 = log.\ 300 - log.\ 0.1 = 3.4771213,$$

and the length of the first and of the third scales will be 3.477 × the modulus selected. On the 10-inch slide rule the scale of numbers measures 250 millimeters and that of the cubes 83⅓ millimeters. If this length is adopted as a modulus, the first and third scales will be

$$3.477 \times 83\tfrac{1}{3} = 289.7\ millimeters,$$

or about 11.4 inches long. This, of course, is somewhat reduced in chart No. 1 for reproduction, but the proportions remain the same.

Finally,

$m_1 =$ 83⅓ millimeters
$m_2 =$ 166⅔ millimeters
$m_3 =$ 83⅓ millimeters.

Resorting now to the constant

$$\frac{1}{\sqrt[6]{0.62\ (D+1)}}$$

each diameter marked on the second scale must be so located as to take this constant into account. The plan followed in this instance is as follows: The diameters selected ranged from 2 to 48 inches, and the expression of the constant was transformed thus:

$$\frac{D^3}{\sqrt{0.62\ (D+1)}} = \left(\frac{D}{\sqrt[6]{0.62\ (D+1)}}\right)^3$$

For each diameter, the corresponding value $\frac{D}{\sqrt[6]{0.62\ (D+1)}}$ was calculated and inserted on the scale instead of the diameter itself. Instead of plotting, for instance, 8, 12, 20, 36 and 48 inches, there were inserted 6.007, 8.475, 13.04, 21,357 and 27.111 inches.

This case is somewhat out of the ordinary, and if it had been necessary to have the scale of diameters continuous, the process would have been extremely tedious.

To locate the beginning of the second scale it is necessary to calculate exactly the corresponding value of the frictional head for one given diameter and a given value of gallons per minute. The position of the number representing the diameter is given by the intersection of the straight line joining gallons per minute and the friction head with the line on which the diameter scale is established.

The treatment of boiler water with lump and with hydrated lime has been tested by C. E. Thomas, general foreman of waterworks, Illinois Central Railway, whose findings regarding the comparative merits of the two materials are embodied in a paper before the Illinois Water Supply Association. A test was made on 24 tanks, each containing 65,000 gallons of water; 12 tanks were treated with hydrated and 12 with lump lime, 3432 pounds of hydrated lime and 2808 pounds of lump lime being used. Although about 22 per cent. more of hydrated lime than lump lime was used, the lower cost of the hydrated lime showed a saving of about 3 cents per tank over the lump lime. A more uniform treatment was maintained by the use of the hydrated product and the uncertain and deteriorating effects of storage upon lump lime were eliminated.

Uses of the Steam Engine Indicator

By H. T. Fryant

The importance of a proper reducing motion, the uses and limitations of an indicator, and some of the faults in engine adjustment as shown by the diagram.

Many engineers own indicators but comparatively few make a study of them with a view to what can be accomplished by their use. First, the indicator shows how nearly correct the valves are set; second, whether the valves or piston rings are leaking; third, the drop in steam pressure between the boiler and the engine; fourth, whether the compression is correct for the speed and weight of the moving parts of the engine; fifth, the back pressure; sixth, if the governor rods (when the engine is of the Corliss type) are properly adjusted to obtain the same cutoff at both ends; seventh, if the engine will run away when the governor is at its highest position, and eighth, the horsepower of the engine. Several other things can be learned from an indicator diagram, but these are the principal uses.

The most important thing to do when attaching an indicator to an engine is to have the drum move in unison with the crosshead; otherwise the diagram will be misleading. To illustrate this, assume that the engine has a 36-inch stroke and the indicator diagram is 4 inches long. In this case, one-ninth of the length of the card represents 4 inches of the stroke of the engine and a loss or gain of 7/32 inch in the travel of the drum would throw some of the events out nearly 2 inches. This shows the absolute necessity of having a correct reducing motion. The indicator is poor enough at its best, but, at the same time, it is the only thing which shows what is going on in the cylinder, and if properly attached it will be correct within 1 per cent. A few years ago the expert was the only man who did indicator work; the engineer had to take a back seat and was not supposed to know anything about this mystery; this day, however, is fast passing.

Considering the uses of the indicator as enumerated, the first is valve setting. Some claim to be able to set the valves by shop marks just as well as with the aid of an indicator. It is a fact, however, that every engine builder uses an indicator to prove the correctness of the shop marks. Even assuming that it is possible to set the valves on a simple Corliss engine by the shop marks, it is not so easy to take off all the bonnets to ascertain which valve is out of adjustment when there is a twisted stem or something else causing the engine to run badly or use more steam than necessary.

Regarding leaks, the indicator shows these better than any other way, and it does not require much study of the subject to be able to detect them. Many managers are learning to read this much about a diagram, realizing that if steam is leaking by the piston or valves, it means more coal.

The drop in steam pressure between the boiler and the engine as shown by the indicator is important. If this is found to be great, it may be reduced in some cases by taking out some of the short bends, small pipe, etc., which obstruct the flow of steam. The greater the drop in pressure, the longer the cutoff will be for a given load; the terminal pressure rises and so does the coal bill.

It is a well known fact that greater compression is required for a crank type of engine than for one of the disk type, and that it requires more on the head end than on the crank end. The greater the speed the greater the amount of compression necessary, but an indicator is about the only thing which will show how much compression the engine is running with.

The diagram will show whether the back pressure is higher than it should be, and if this is found to be the case, it may often be lessened by straightening the exhaust pipe.

As for equal cutoff, some claim they can tell this by the sound of the exhaust. This may be true, but sometimes it is hard to tell which end has the earlier cutoff. If the cutoff on one end is so late that it produces 15 pounds terminal pressure and the other is so early as to expand down to 3 inches of vacuum, it will not only cause a bad running engine, but will take much more steam than if the cutoff were the same on both ends. This can be detected accurately only by applying an indicator.

If the engine takes steam when the governor is at its highest position, it will run away. This has caused a number of flywheel explosions. It is possible to detect this without the indicator, by blocking the governor and turning over the engine, but it is much easier to use an indicator.

Considering the diagram itself, if the steam valve opens at the instant the piston is at the end of its stroke, the admission line will be vertical and at right angles to the atmospheric line, because the drum will be practically standing still. If this line leans in it shows that the valve is opening late, and if it leans out the valve opens before the piston reaches the end of its travel. If the card is 4 inches long with the stroke of the engine 36 inches and the admission line leans out 1/9 of an inch, the engine will be taking steam one inch before the piston reaches the end of its stroke; or if the line leans in, the engine will be taking steam one inch after the piston leaves the end of the stroke. Now, consider that portion of the diagram representing the travel of the piston from the beginning of the stroke up to cutoff. For this line to be theoretically correct, it should be parallel with the atmospheric line but in practice this is never so, as the piston travels faster than steam is supplied to hold the pressure up, and as the piston moves faster at the head end, the drop is always more marked on this end of diagram. The next portion of the line is curved, this being caused by the closing of the valve; the slower the valve closes the more rounding this line will be. If a square corner were present instead of the curved line it would show that the valve had closed instantaneously. Next comes the expansion line which closely resembles the hyperbolic curve; the variation of this expansion line from the theoretical line is due chiefly to leaks, reëvaporation, reopening of the valves, etc. If the engine is of the simple, single-eccentric type, this line should extend down to the atmospheric line at the end of the stroke. Many engines are too small to do the work required of them. This makes the cutoff so late that the full benefit of expansion is not attained.

At release the line makes a sharp turn, forming what is called the toe of the diagram. Sometimes this toe will turn down and even go below the atmospheric line, but on most single-eccentric engines it does not get down to the atmospheric until the piston has moved back 4 or 5 inches on its return stroke. This could be remedied to some extent by moving the eccentric ahead, but this is not advisable on most engines, as it makes the range of cutoff too short and the valves will not release.

Next is the back-pressure line. This line is usually above the atmospheric line, which is caused by pressure backing up in the exhaust pipe. It is good practice to take a diagram direct from the main steam pipe just above the throttle, and then, without removing the card, connect the indicator to the cylinder and take another diagram.

As to the amount of compression which should be used it may be said that just enough should be employed to make the engine pass over its centers without a pound. If an engine has a noncompression pound, it is nearly always on the head end. This is because the speed at that end is the higher, caused by the angularity of the connecting rod.

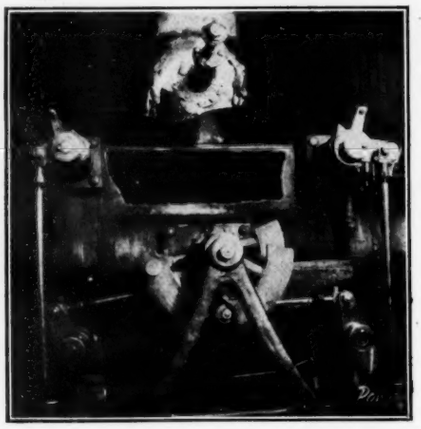
Any man who is interested and lets his firm see that he is interested, will not have much trouble in securing an indicator.

A Wrecked Engine Cylinder

By C. L. Greer

The accompanying photograph shows an unusual mishap to a 1000-horsepower compound engine which necessitated the buying of a new cylinder and which might have occasioned loss of life which it fortunately did not.

While operating, the side wall of the



Wreck of High-pressure Cylinder

steam chest of the high-pressure cylinder let go on the valve-gear side with the result shown. As may be seen, the whole side was blown out. The flying fragments left only the hub of the throttle handwheel on the stem, broke both steam cranks smooth off, took away the top of both steam and exhaust wrist-plates (made in wheel form) and broke one of the reach rods on the low-pressure side.

The plant being overloaded a temporary steam line was run to the low-pressure cylinder, the high-pressure crank was disconnected and the engine delivered half power from the low-pressure side.

The cause of the break is not known.

Smoke Abatement

Professor Watkinson, Liverpool University, delivered the fourth of the lectures for stokers and others interested in furnace management in the lecture theater of the Walker engineering laboratories at Liverpool on Friday evening, February 17, taking as his subject, "The Setting and Construction of Boilers and Furnaces, and the Methods of Producing Natural, Forced and Induced Draft."

After a few opening remarks dealing with the general aim and purpose of the lectures, and with the importance of accurate measurements of draft, temperature, steam pressure and of the composition of the exit gases as an aid to good work in boiler management, the lecturer dealt with the three conditions requisite to obtain good combustion of solid bituminous fuels and showed experimentally how essential these were to smokeless combustion. The details of construction of a Lancashire boiler were then illustrated by aid of lantern slides in order to prove the difficulty of obtaining smokeless combustion in this type of boiler, a difficulty due to the small furnace and the arch of water-cooled plates over the furnace grate. The purpose of the bridge was then discussed, and the lecturer stated that it produced eddies in the gases as they passed over it into the flue beyond, and therefore tended to promote mixture of the hot air and hydrocarbon gases given off from the burning fuel. A high bridge was therefore better than a low one, if sufficient draft could be obtained to work the boiler fires with it. In the absence of good draft the use of steam jets was often resorted to in order to increase the air supply and to promote the better mixture of the air and furnace gases. In the Belleville type of marine boiler, air at 30 pounds pressure was employed in place of steam, and the Howden system of forced and preheated draft was now generally employed for marine work; but this system in spite of its many advantages had not been adopted for boiler installations on land. Natural draft produced by a chimney rarely exceeded ½ to ¾ inch, measured by a water gage. This low draft limited the thickness of the fires and rendered it exceedingly difficult to keep the fuel lying on the furnace bars free from holes. For good combustion with thick fires, on the other hand, forced or induced draft was essential, and this was now generally recognized and adopted. The different methods of obtaining artificial draft were then discussed, and the comparative advantages of steam jets, air jets and fans were dealt with by the lecturer. As compared with steam jets, fans were more costly to install, but saved largely in running cost, a good fan requiring only 5 per cent. of the steam produced, in place of the 10 to 12 per cent. used by steam jets. The statements made by the makers and other interested parties that steam jets only consumed 3 per cent. of the steam were absolutely inaccurate.

The different methods of furnace construction and the use of firebrick arches for conserving heat and promoting good combustion were then dealt with. It was pointed out that a firebrick arch by increasing the temperature of a furnace may actually increase smoke production, owing to the greater rapidity with which the hydrocarbon gases will be evolved from the freshly charged fuel, unless precautions are taken to greatly increase the air supply at the same moment. The dutch-oven type of furnace construction for Lancashire boilers was condemned by Professor Watkinson for the reason that from 40 to 60 per cent. of the heat transfer in this type of boiler is by radiation from the glowing solid carbon lying on the bars of the grate to the plates above, and this radiation can only occur to the full extent when the furnace is inside the boiler. Luminous flames radiate heat also, but not to the same extent as glowing solids. Although steam boilers can be worked efficiently with the gaseous fuel, they require to be specially constructed for this duty, and no ordinary type of Lancashire boiler will give high efficiency with external furnace or with producer gas. The use of economizers was finally discussed, and the two chief types were described.

The lecture was illustrated by numerous experiments and lantern slides, and was followed by an exhibition of apparatus for making draft, temperature and the other measurements incidental to good boiler management.

The Stumpf Unidirectional Flow Steam Engine

In previous issues of Power, and particularly the January 31, 1911, number, the design and method of working of this type of engine have been given considerable attention. Since the date men-

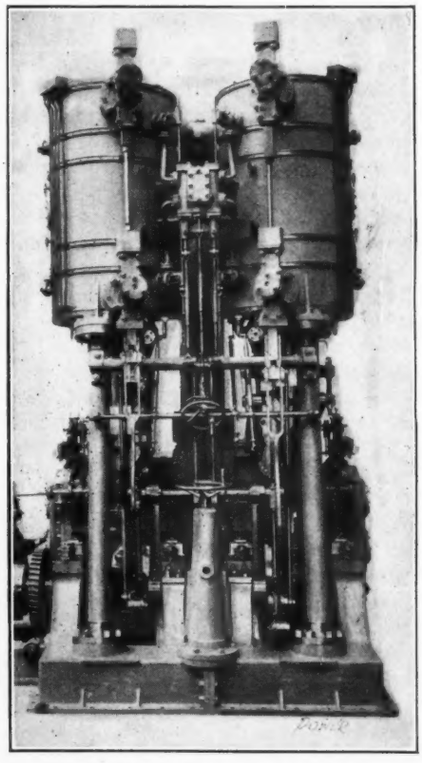


Fig. 1. Second Marine Engine Built of Straight-flow Principle

tioned above, some illustrations of a marine engine and locomotives employing the straight-flow principle have come to hand and are presented herewith.

Fig. 1 is a photo-engraving of the second marine unidirectional-flow steam engine of this system. It was built by the Stettiner Maschinenbau Aktien Gesellschaft at Stettin-Bredow.

Fig. 2 illustrates an express locomotive, and Fig. 3 is a view of a locomotive

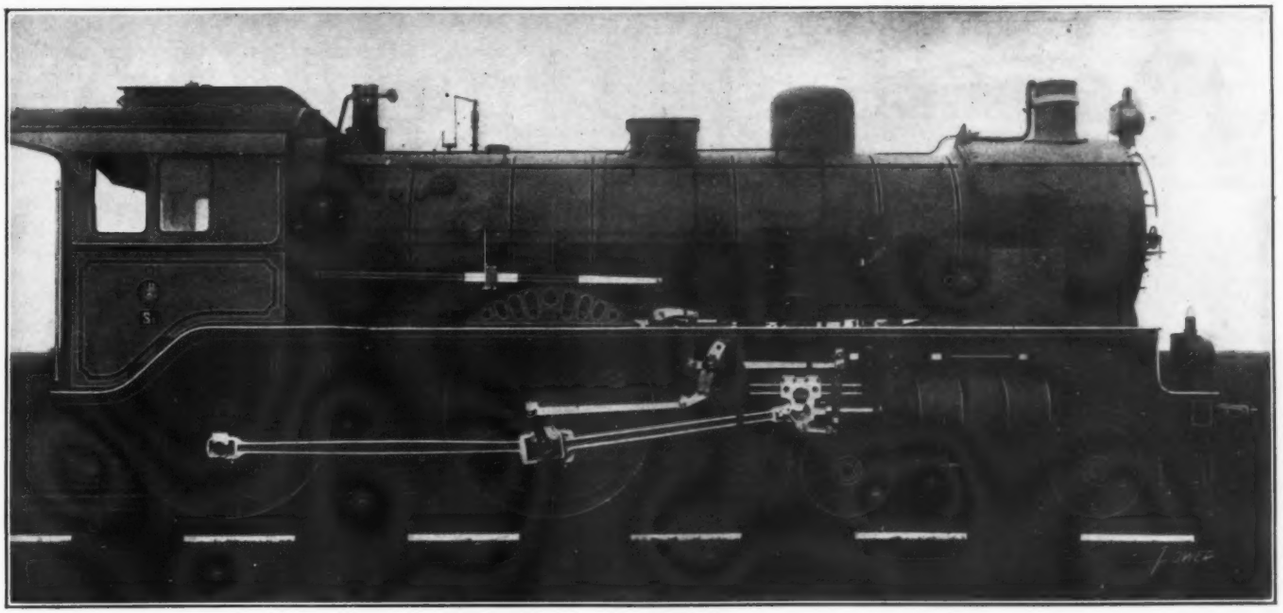


FIG. 2. AN EXPRESS LOCOMOTIVE UTILIZING STUMPF PATENT

exhibited at the Brussels exposition. Both of these locomotives have been in successful operation for several months, and six duplicates of the type exhibited have recently been put into successful operation.

Fig. 4 is a cross-sectional view of the cylinder of a locomotive which has five drivers and weighs approximately 85 tons. Five of these locomotives have been ordered by the Moscow Kasan Railway, and at present are in the course of construction.

Engines working on the unidirectional-flow principle are apparently making great headway in Europe, and it is only natural that they should for the efficiency of a single cylinder is practically equal to the best figures obtained with compound and triple-expansion engines.

On a 300-horsepower engine with a cylinder 23.5 inches in diameter, a steam consumption of 8.5 per indicated horsepower-hour was obtained. Besides the merit of high economy the straight-flow engine has a flat-efficiency curve, which means a steam consumption on fractional load or overload of but little more than at normal load.

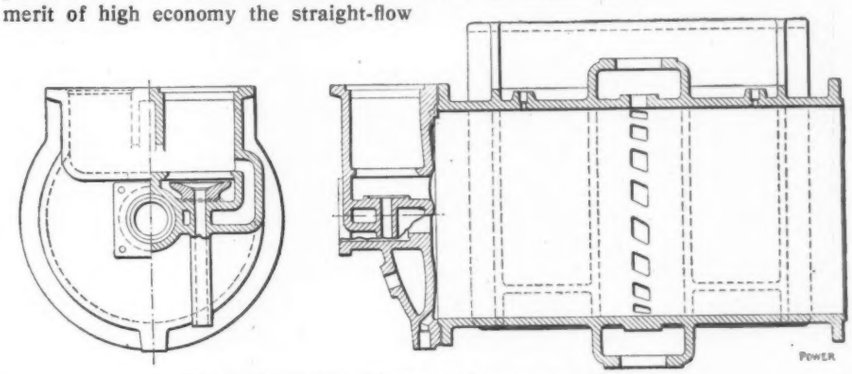


FIG. 4. SECTIONAL VIEWS OF LOCOMOTIVE CYLINDER

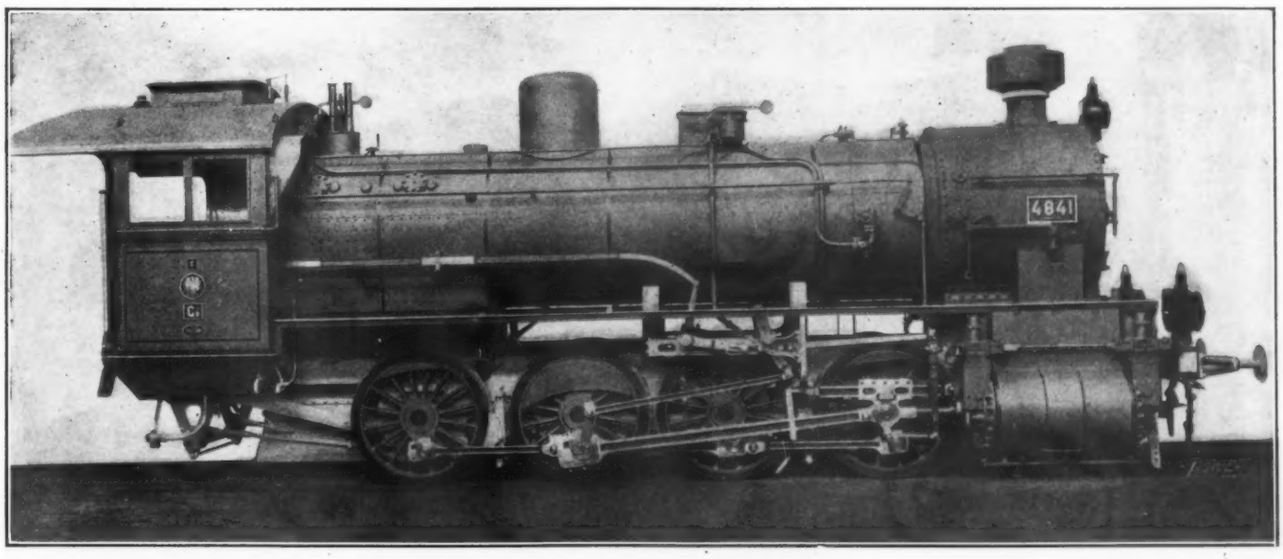


FIG. 3. LOCOMOTIVE EXHIBITED AT BRUSSELS

Electrical Department

Especially conducted to be of interest and service to the men in charge of the electrical equipment

A Thriving Power Plant Developed by Protecting Low Ground from Floods

By D. A. Willey

The extent and variety of operations that may be actuated from a small water power are well illustrated by a canal in the Salt river district of Arizona. The

Fig. 1. Dam and Power House at End of Canal

locality which it serves has no available coal or wood for generating steam and depends entirely upon the electric current generated by the water flowing from the Salt river through this canal. To obtain the necessary hydraulic head the head gates of the canal were located on the Salt river 20 miles above the power station. The width of the canal is 15 feet at the top and 10 feet at the bottom; the minimum depth is 10 feet. The water is delivered from the canal through steel pipes to turbines direct-connected to alternating-current generators. Three of these units are rated at 900 kilowatts each, working under a head of 226 feet. The other three units comprise two of 900 and one of 1500 kilowatts, getting water under heads which range from about 70 to 220 feet.

A maximum of 4400 electrical horsepower is generated and is utilized for the following purposes: Lighting two communities, operating a tram road six miles long and operating a series of electric pumps to irrigate 50,000 acres of land. During the construction of the Roosevelt dam the plant furnished power for actuating aërial cableways for conveying stone blocks, cement and other material for dam construction, and driving the motors in a cement mill producing 1000 barrels daily.

The current is stepped down to the proper voltage for service and distributed from the transformer station by a steel-tower transmission line carrying six wires of stranded hard-drawn copper. For the irrigating pumps the wires are carried on tripartite poles of varying hight, depending on location and the length of the line and topography of the country through which it passes. At a point about a mile east of the town of Mesa, a switching station is installed from which a line leads south into the pumping territory where 1000 horsepower is used for pumping. The wells have been drilled and many of the lateral canals built into which the water is pumped and otherwise diverted from the Salt river during floods. In all, thirty pumps are operated.

Seven miles south of Mesa the line enters another pumping territory and here ultimately from 20,000 to 40,000 acres will be served when the necessary machinery is installed. The pumping units are vertical-shaft centrifugal pumps direct-connected to 50-horsepower induction

Fig. 2. Part of 20-mile Canal from Salt River to Power Station

motors supplied with current at about 220 volts and 25 cycles.

The main transmission line carries current at 45,000 volts and the main distributing lines operate at 10,000 volts. The line mentioned as running south to the Indian reservation is a 45,000-volt line. There is a substation eight miles south of Mesa in which the transformers change this voltage from 45,000 to 10,000. The main transmission line continues through Mesa and terminates at the present time in Phœnix, 78 miles from the power source, where power is furnished to light the city.

The cement mill was constructed to furnish concrete for the Roosevelt dam and dismantled after the dam was completed. Its equipment, consisting of the separators, material conveyers, grinding and pulverizing apparatus, was operated by a number of motors through shafting and belting. The operation of this cement mill was one of the principal objects for which the power plant was established but the other industries which it serves have given it permanent usefulness.

LETTERS

Geared Dynamos and Turbines

The article by George W. Malcolm on "Reduction Gears for Turbine-driven Direct-current Generators," in the issue of February 14, comparing the efficiency of turbine-driven direct-current generating sets with and without gears, fails to include several important elements. Mr. Malcolm attempts to show that in order to attain an overall efficiency from steam to switchboard of 52.2 per cent., as claimed by advocates of the geared outfit, it is necessary to assume either an impossibly high generator efficiency or an impossibly high turbine efficiency.

For one thing, Mr. Malcolm's assumption of 97 per cent. as the efficiency of a gear of this character is too low, if applied to accurately cut gears; 98½ per cent. would be nearer the correct figure. The efficiency of such gears is not a matter of doubt or guess-work, since it can be determined within a very small percentage of error. With a gear efficiency of 98½ per cent. the figures for turbine efficiency and geared generator efficiency would be as follows:

Turbine Efficiency.	Generator Efficiency.
54%	98.2%
56	94.7
58	91.4
60	88.5

A turbine efficiency of even 60 per cent. is well within the limits of possibility for a 1000-kilowatt turbine, especially if advantage be taken of the gear to increase the speed of the turbine, as well as to reduce the speed of the generator. Doubling the speed of the turbine would reduce the number of stages of a velocity-stage turbine to one-half or those of a pressure-stage turbine to one-fourth, resulting not only in increased efficiency but possibly also saving more than enough on the cost of the turbine to pay for the cost of the gear.

Moreover, according to the above table, the generator efficiency would need to be only 88½ per cent., although there should be no difficulty in reaching 95 per cent. if the speed of the geared generator be only one-fifth that of the direct-coupled generator.

Further, Mr. Malcolm entirely ignores the many practical advantages of the standard-speed direct-current generator as compared with the high-speed generator for direct connection to turbines. Among the many disadvantages of the high-speed direct-current machine may be mentioned the following: Proper commutation involves carefully designed interpole construction; as the diameter of the commutator is limited by the allowable peripheral speed, it is usually necessary to use a double-length commutator in order to obtain the requisite area and keep down the current density within satisfactory limits; the number of commutator bars and distance required between brushes limits the number of poles which may be used; with very long commutators, or with two commutators in tandem, there is difficulty in securing uniform distribution of current between the different brushes on each brush arm; very careful shop work is required; the increased length of shaft necessary to accommodate the commutator increases trouble from vibration, which in turn interferes seriously with the commutation, especially if carbon brushes be used; while it is difficult to compute the critical speed of a direct-current armature, it is very important that that speed be not approached, also that the commutator and armature be in perfect balance; due to drying out or other change in the insulation after the commutator and windings have been assembled, there may be a displacement of the center of gravity which will give rise to vibration entirely beyond the skill of the attendant to remedy, making it necessary that the armature be sent back to the manufacturer for readjustment; the necessity of limiting the diameter of the armature restricts the space available for insulation and for armature windings, so that it is doubtful if the increased windage, iron losses and friction would be neutralized by a decrease in the purely electrical losses, as claimed by Mr. Malcolm; due to the very high speeds at which the armature must run, and the necessity of passing a large amount of air through it in order to keep it cool, there is a great tendency for the collection of dust, including carbon dust from the brushes, and it is found that under high-speed conditions, this dust assumes a very compact form, which frequently results in short-circuits or grounds; finally, while the standard speed electrical generator is entirely familiar to the ordinary operating man, who can make any small repairs as they may be required, the repair of the high-speed generator is entirely beyond both his knowledge and his facilities.

The majority of dynamo designers appear to be of the opinion that units of 1000 kilowatts should not exceed a speed of 1500 revolutions per minute and this speed has in fact been found most suitable also for much smaller machines, even down to 500 kilowatts. However, by installing a 10 to 1 gear, the speed of the generator can be reduced to 300 revolutions per minute, which is moderate and the usual speed for waterwheel-driven generators; at the same time the speed of the turbine can be doubled to 3000 revolutions per minute, which will permit the use of a much shorter, simpler structure, less liable to give trouble by vibration, rubbing, etc., than a longer turbine running at a slower speed. In addition to the saving by the reduced size of the turbine, there will be some saving in the cost of the generator, so that there will be no difficulty in covering the added cost of the gear.

GEO. H. GIBSON.

New York.

Mr. Gibson's assumption that I "attempt to show" that Mr. MacMurchie's economy figures are impossible appears to be due to a lively imagination; it certainly has no foundation in fact. All that my tables were intended to show is a list of possible combinations which would fit Mr. MacMurchie's steam figures. For the benefit of Mr. Gibson and any other readers who may feel impelled to read into my article a forced and sinister meaning, it may be advisable to state that the argument of the article was merely to the effect that the use of the Melville-Macalpine gear for connecting direct-current dynamos with turbines other than the De Laval would not make possible a higher dynamo efficiency and would probably not be of enough advantage to make it pay.

As I am informed that the builders of the gear claim only 98 per cent. efficiency for it, Mr. Gibson's slightly generous allowance is academic; furthermore, as no machinery except waterwheels and grindstones has ever succeeded in maintaining in actual service an efficiency equal to that developed in the maker's test, my allowance of 97 per cent. is quite rational.

Mr. Gibson's attempt to explain the effect of speed upon the design of a direct-current dynamo would be more interesting if it were entirely accurate and if even a corrected version refuted or were relevant to any argument that I have advanced. Anyone who has the least familiarity with the subject knows that very high speeds entail serious commutation difficulties; if I had claimed the contrary to be true, Mr. Gibson's fifth para-

graph might have been justified. As it is, he has merely indulged in the superficial pastime of demolishing a Frankenstein of his own construction.

GEO. W. MALCOLM.

Brooklyn, N. Y.

Cutting Out the Compounding of an Alternator

I was once called to correct trouble on a single-phase compound-wound alternator which was reported as failing to hold the voltage up when running at full load. Fig. 1 shows the connections of the alternator as they were found. To simplify the sketch only two commutator segments are shown, but in reality there is always the same number of segments as of field-magnet poles.

Those familiar with this type of alternator know that the main armature current is rectified by the commutator *A* and passes through the series field winding. In this way the extra field excitation is obtained that is necessary to overcome armature reaction and to hold the voltage normal at full load.

After testing for faults in the machine, I found that the commutator was short-circuited, cutting out the current that should have gone to the series field winding. The repair of this commutator would have been a somewhat difficult job without having factory facilities, so I decided to do away with the compensating feature and connect the machine as shown in Fig. 2, also reinforcing the short-circuit of the rectifying commutator *A;* a piece of wire was wound around the commutator for this purpose. The series field winding was connected in series with the main field winding, the coils of which were connected in parallel-series, as shown, and the combination was connected to the exciter. This increased the load on the exciter, but it was large enough to stand it. We had no difficulty in holding the voltage at full load and the operator was so pleased that the commutator and brushes had been cut out that we decided to leave the machine connected that way permanently.

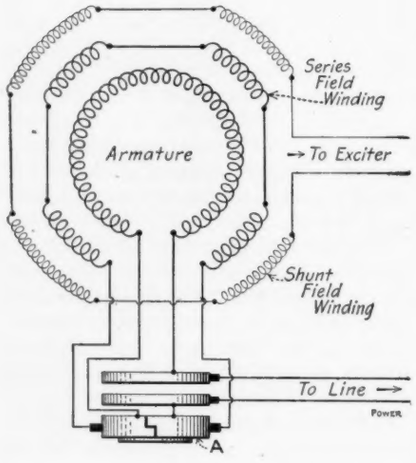


FIG. 1. ORIGINAL CONNECTIONS

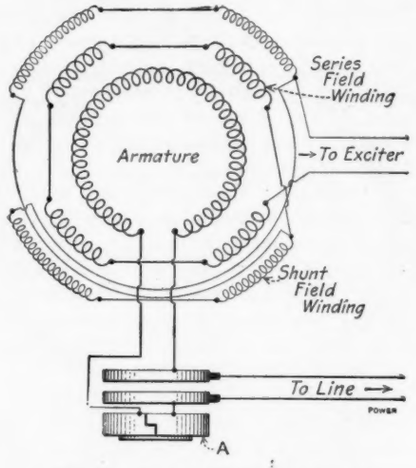


FIG. 2. CHANGED CONNECTIONS

G. J. REYNOLDS.

Anniston, Ala.

Mr. Hull's Erratic Belt

From reading Mr. Hull's letter in POWER of February 14 it is evident that the two pulleys do not line up or the two shafts are not parallel, that is, one of them is not level—perhaps both.

The reason the belt runs true with the center of the pulleys when loaded and shifts from one side to other in stopping and starting is that the crown on the pulley guides the belt true with the center when it is pulling a load and tight, but when starting or stopping the belt is slack enough to run to the edge in response to the unsymmetrical influence of the pulleys.

If it is an endless belt it may have been glued together crooked, that is, with one edge longer than the other.

N. E. WOOLMAN.

Danbury, Iowa.

The erratic belt behavior described by W. S. Hull in the February 14 issue of POWER appears to be a duplicate of an experience I had with a similar outfit. In my case the trouble was due to the fact that oil worked out onto the flywheel from the engine bearing and moistened the inside half of the belt when running, causing that half to stretch. This forced the outside half to carry most of the load and that half, under the extra strain, stretched also; this enabled the belt to adjust itself true to the center of the pulley when the load was on it. As the outside half was dry, however, it contracted back to its original length when the load was taken off and then the belt was crooked, which accounts for its not staying on the center of the pulley when starting and stopping.

I opened the seams on the stretched side and tried taking up on them, but this did not help much as the belt was still stretched between the seams. I then tried to stretch the short side to match the other side by moistening it while it was running, also putting more tension on it, but with no better results.

By experimenting with the belt-adjusting wheel on the generator I learned that by reducing the tension on the belt before shutting down and increasing it before starting, the belt would run true with the center of the pulley. The amount of tension in each case must be determined by experiment.

This remedy, however, is not absolute, for, although an engineer may be able to operate the belt in this manner by careful attention, the load may suddenly change on the generator when he is not near to attend to the belt, or someone else may start the engine and cause a wreck that would be far more costly than having the belt put in proper condition. It should be sent to a belt manufacturer to be cleaned and straightened and the seams made over. In the mean time, I advise Mr. Hull to make sure that the pulley is in line with the driving wheel and the foundation bolts are tight; also, not to allow the generator to swing when the load is on it and to see that no water is allowed to drip on the belt from the roof or piping.

J. W. BLAKE.

New York.

If Mr. Hull, who had a letter in POWER for February 14 regarding a dynamo belt, will test the face of the pulley with a straight-edge he will probably find that it has worn slightly hollowing in the center. This can be corrected by building up the center of the pulley by winding strips of thick paper around it. The paper can be fastened on with either glue or shellac; shellac will resist both oil and water, but Mr. Hull probably does not let either get on his dynamo pulleys. By using strips of paper of different widths the pulley can be built up so that it will have any desired crown. I have had a similar experience which was corrected in the manner described.

G. E. MILES.

Salida, Colo.

German interest is greatly aroused in the proposal to utilize the power of the Tinfos, which is estimated at 15,000 horsepower, to supply the energy for electrifying the whole of the Tinfos iron works. By the summer of 1911 it is estimated that one-third of the power will be in use for the electric furnaces, and that twelve months later the head of water will be fully utilized.

Gas Power Department

Everything worth while in the gas engine and producer industry will be treated here in a way that can be of use to practical men

A Composite Pressure and Suction Producer Plant

The accompanying engravings illustrate an equipment of pressure gas producers in a New England manufacturing plant, together with some details of the producer construction. Figs. 1 and 2 show the plant of three generators and the charging floor, respectively. Fig. 3 is a sectional elevation of one of the generators. The inside diameter is 8 feet and the generator is rated at 400 pounds of coal per hour on a 24-hour basis, burning approximately 12 pounds of coal per hour per square foot of grate surface. The generator is a heavy steel cylindrical shell, firebrick lined and set in a concrete pan; the shell is supported by four legs of structural steel, one of which is visible in Fig. 3. Coal is charged through double-sealed hoppers which rest on water-cooled tops, and poke holes are located at convenient points; the holes are closed by finished plugs and the construction is such that the poking bars cannot injure the finished surface and wear the holes out of true. A simple cast-iron bell is used in the feeding hoppers, held to its seat with a counterweight, as indicated in the illustration.

A notable feature of the generator is the annular tuyere, of dog-house cross-section, which distributes air and steam throughout the bed of fuel with an unusual approach to uniformity. The annular outline of the tuyere facilitates the removal of ash, as the latter can descend both around the outside and through the inside opening of the annulus. The tuyere is supplied with air and steam by two blowers of the Körting type, located at opposite ends of the diameter of the tuyere; this, of course, tends to uniform distribution.

The gas from the generator passes through an economizer consisting of two concentric circular shells of heavy steel plate, the gas passing through the inner shell and the air for the generator passing through the outer one in the opposite direction. Most of the available sensible heat that is in the gas when it leaves the generator is taken out in the economizer by the air passing to the blowers, with the result that the air is heated considerably beyond the condensing temperature of the steam used in the blower; consequently, no moisture is precipitated in the bottom of the generator.

Two scrubbers of the combination type are used. In the bottom part of the scrubber the gas is cooled and cleaned by means of a spray of water and a bed of coke and the upper portion is filled with excelsior for removing the moisture entrained by the gas passing upward.

Fig. 4 is a sectional elevation of a three-way water-sealed valve that is used at the junction of the purge and scrubber pipes. With the valve bucket in the position shown, the purge pipe is sealed off and the gas passes to the scrubber through the bottom outlet.

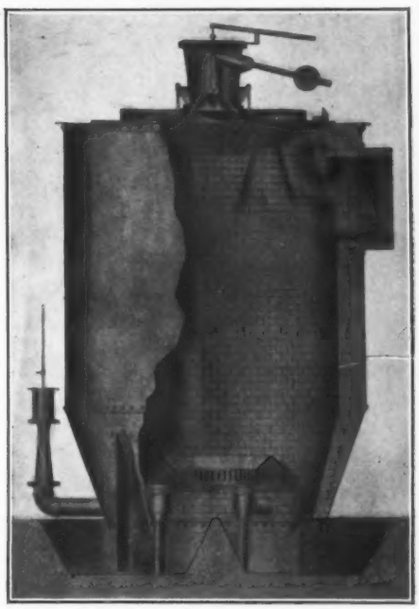


FIG. 3. GENERATOR CONSTRUCTION

An unusual feature of this plant is the use of both suction and pressure to create the draft through the generator. Perhaps it would be more accurate to say that suction is used incidentally in addition to the steam blowers, not necessarily. Positive blowers are connected between the scrubber outlet and the delivery main

FIG. 1. THE PRODUCER PLANT

FIG. 2. THE CHARGING FLOOR

in order to maintain an actually constant pressure in the main, and these, of course, subject the generators to suction. The inlet and outlet of each blower are connected by a bypass in which is a regulating valve that allows some of the gas

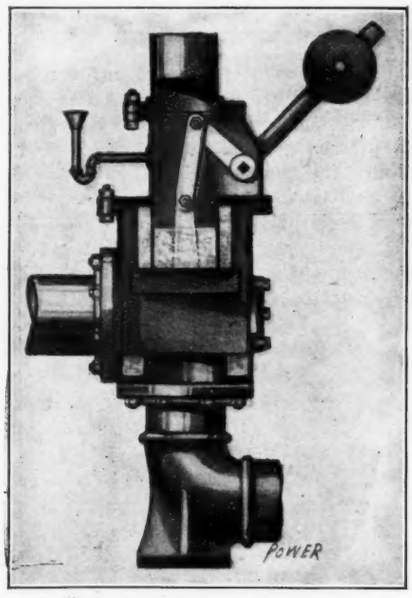


FIG. 4. WATER-SEALED VALVE

merely to circulate in the pump when the pressure in the main is normal. The pumps or blowers and their connections are illustrated by Fig. 5. To reduce the liability to shutdowns, one of the blowers is driven by an electric motor supplied with current from the central station of the town and the other one, which is nor-

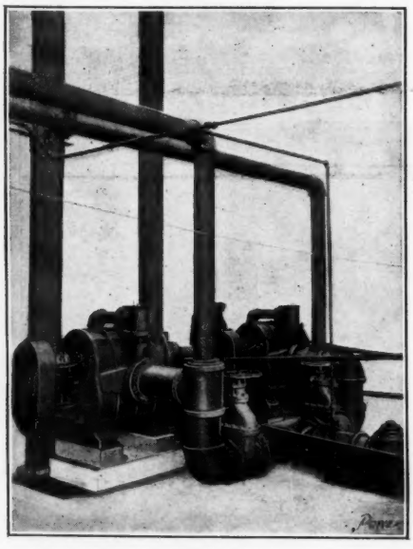


FIG. 5. THE GAS PUMPS

mally used, is driven by a small vertical engine supplied from the boiler which makes steam for the gas generators.

The coaling arrangements are so clearly shown in Fig. 2 that a verbal description is not necessary. A simple but excellent feature of the building is that the charging floor is open on the side toward the auxiliaries on the floor below, so that the operation of the pumps can be observed from the charging platform.

The equipment was designed and built by the Flinn & Dreffein Company, of Chicago.

Gas Power Plant Erectors and Operators

BY W. E. NELSON

Do gas engines and producers need engineers, and do gas-engine and producer manufacturers need information or advice from the erecting men? Many manufacturers depend upon their engineering talent in the office and drafting room to work out the details and turn out a machine that will give reliable service, depending upon an indicator card, a brake test of two hours and one or two observations of the engine's performance while running nicely under a moderate load.

Two plants practically alike were installed under different conditions; one of them was accepted and the other rejected. The one that was rejected was installed by an engineer from the office and the other one by an erector from the test floor. Before the office engineer had gained enough practical experience to get his plant to operating successfully it was too late for a practical man to do any good.

On the other hand, many gas-engine installations that were installed by practical men have been rejected through the fault of the manufacturers in not sending men that were adapted to the particular line of work to be done. An experience with a small municipal electric-light plant will serve to illustrate one way in which the manufacturers are to blame for poor installations and unsatisfactory operation. The plant equipment consisted of a 55-horsepower engine and suction producer which was sold by a gasolene-engine agent, who, in an endeavor to save as much as possible, sent his regular gasolene-engine erector to install it. The erector was of the type that can use his hands to a good advantage but not his head. In the first place he hired a hobo who was looking for a day's work to put in the firebrick; the result was a leaky lining. He next piped the jacket water from the engine into the scrubber; the result was that the engine got warm gas laden with tarry vapors and small particles of dust that were carried over in the vapor. The next mistake and most serious was neglecting to open a drain which relieves the vaporizer of the water that does not vaporize, which resulted in filling it up to the air intake and shutting off the supply; this caused the engine to back-fire, slow down and finally stop. The manufacturers left a 2-inch pipe flange on the engine intake after testing it on natural gas; the erector connected about four feet of 2-inch pipe to the intake and connected that to the 5-inch gas main with a reducing coupling.

I am not criticizing the man; my object is to emphasize the advisability of employing men trained to do this particular kind of work intelligently; they cannot be hired for $60 a month.

The erector left the plant in the condition described and the town hired a local man to run it; he burned out a dynamo bearing the first week. They tried two or three other men and finally shut the plant down and notified the agent to take it out. He, as a last possible resort, wired the factory for a man, informing them that he must be a diplomat as well as an expert in every sense. The man who was sent was neither a diplomat nor an expert in the usual sense of that title, but he was instrumental in putting the plant in good condition and getting it accepted. In order to get a settlement the agent had to sacrifice the profit and considerable more, which would have made up the extra cost of a good man for several years.

In another plant, poor repair work on a generator lining was done by the operating engineer. The firebrick being badly burned out in the lower half of the generator, he decided to replace all of the badly burned brick; in finishing up the lower half of new brick he found that it did not connect with the upper half, of old brick, by nearly half an inch, so he filled the crack with fire clay. It held until it dried out; then the engines would slow down and would not carry full load, the producer would get a mixture of air and gas in the top and ignite it and blow dust and fine coal out at every joint. The greatest inconvenience would occur when cleaning the fire with the cleaning door open. It was not long before the engineer telephoned the factory for a trouble man; he had blown the fire several hours and could not get good gas at the engine. Upon inspection it was found that a trowel could be inserted all the way around the lining, in the crack between the old and the new parts of the lining.

A good rule to follow in replacing burned-out brick is never to replace them higher than half way to the extreme fire line, and then the greatest care should be taken to fit them perfectly; in case it becomes necessary to replace any more it is best to remove all the brick to make sure of getting a good tight lining. It may cost a little more at the time but will be a great saving in the long run.

Up to the present time there has been very limited publication of the experiences of gas-engine and producer men. Talking with several of them has given me the impression that they are laboring under the delusion that their experiences are too valuable to give away; the other fellow can find them out the same way they did. This is about as unprogressive and senseless as anything can be.

Readers with Something to Say

Practical information from the man on the job. A letter good enough to print here will be paid for. Ideas, not mere words wanted

The Oil Disappeared

During the summer months it was the custom to stop the engine, and not close the stop valve on the boiler, but as cold weather set in it was closed, and after draining the pipes, the throttle was also closed to prevent any leakage running into the drains and freezing.

Since that time I have been wondering why the engine took so much oil, as the oil pump had not been tampered with. One morning the engine had been running about an hour when the cylinder began to groan.

I looked into the oil-pump reservoir, which had been filled the day before, and found it empty. In thinking it over I came to the conclusion that, closing the stop valve and throttle created a vacuum in the pipe and drew all the oil out of the pump in the effort to supply the pipe with air. A cure was effected by opening the bleeder on the oil pump, thus supplying the pipe with air.

FRANK GARTMAN.

Sheboygan, Wis.

Graphite as a Boiler Compound

The value of graphite as a boiler compound is not generally known by operating engineers, and a recent experience in using graphite in boilers that were supposed to be perfectly free from scale may be of interest.

There were two 150-horsepower boilers of the shell type, when the plant came under my supervision, and a chemical compound, costing about $1 per day, was used to prevent scale from forming. The two boilers are in constant use, and evaporated on an average of 3000 cubic feet of water in 24 hours' service. The engineers claimed the boilers were free from scale, and all internal surfaces appeared to be very clean. I decided to try graphite as a scale preventive, on account of its supposed affinity for metals. When graphite is once in a boiler, the circulation of the water carries it to all portions and the graphite forms a thin coating on the metal which prevents the scale from forming. The graphite was ground to a powder, as ordinarily supplied as a lubricating graphite.

For the first two weeks one pint of graphite was mixed with one gallon of water and fed to the suction of the pumps between the feed-water heater and pumps each day. At the end of two weeks, the boilers were opened for cleaning and about 100 pounds of sludge was removed from the bottom of the boilers; this sludge contained considerable scale, about 1/16 inch thick, which appeared to be old scale from the back head. The boilers had been blown down twice a day, and the amount of sludge recovered was about twice that recovered when using the compound. The amount of graphite was then reduced to a pint every other day, and at the end of another two weeks the boilers were again opened and considerable white coating appeared on the surfaces, which at first appeared to be new scale, but on close examination was found to be old scale with the outer surface dissolved. In some places the old scale came off in large pieces, showing that the boiler had been covered with a scale so hard that it had been mistaken for the metal.

At the end of eight weeks one of the boilers showed but a few patches of scale. This boiler was nearest the pump and appeared to receive most of the graphite; however, the other is in as good a condition now, and both appear to be free from scale.

When the compound was used the feed-water line had to be removed every two months, and the scale cleaned out, but since using graphite the feed lines have not been taken down, or does it appear necessary to do so; the pumps are now clean and are not coated with a gritty substance as formerly.

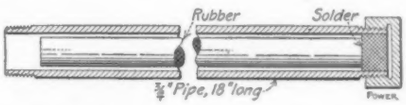
Pieces of scale which came loose from the surface of the boiler showed graphite adhering to it. My experience with graphite shows that it will work in between the scale and the surface of the metal, causing the scale to loosen and fall off. I am unable, however, to explain the apparent dissolving action of the graphite on the surface of the old scale, as there is nothing in its composition to cause this action, that I am aware of, and the amount of graphite used was very small. On account of the steam being used in bleach tanks to heat and agitate the product manufactured in this plant, the color of which must be very white to command the best prices, I was at first doubtful of the results at this point, but during the period the greatest amount of graphite was used, the bleached product was of an excellent color.

E. G. TRUMBO.

Mineral Point, Mo.

Air Chamber on a High Pressure Water Line

In the Singer Tower, New York City, the water service to the various offices was originally maintained by a single pipe line from a pump in the engine room to a tank located about 600 feet above the level of the pump. The outlets to the various offices were tapped directly from this line. The pressure, due to head, was so great that whenever a faucet in one of the lower floors was turned on and off a severe water hammer occurred, which was transmitted over the whole line. The natural remedy was to run a new and separate line from the pump to the tank, and to disconnect the line feeding to the faucets from the pump. Conditions were such, however, that this could not be done for some time and the following simple, but extremely effective device, was used:



SECTIONAL VIEW OF AIR CHAMBER

It consisted of a piece of ¾-inch pipe about 18 inches long filled with solder at one end, and fitted with a cap, as shown. A piece of round, medium soft rubber that easily fitted in the pipe, and about 15 inches long was placed inside. This device was then connected, in a horizontal position, with a valve and nipple to the line about half way between the pump and the tank. After this was installed no more water hammer occurred whenever a faucet was turned on or off in any part of the line, as the rubber absorbed all of the shock and relieved the air chamber entirely.

Later, when it was convenient, a second pipe was put in so that the pump delivered water directly to the tank, and the old line was used to connect the tank to the faucets. After this was done the rubber cushioning device was no longer

needed, but its success demonstrated that, in a case of high-pressure heads in water lines, a rubber cushion is superior to an air chamber on the pump to absorb shocks from water hammer.

H. B. LANGE.

New York City.

Feed Pipe Scaled

The difficulties began with the packing in the boiler feed pump giving out more frequently than a good packing should. It was decided that the packing was at fault and a new brand was tried. This played out in even less time than the previous lot, so the old kind was again used, but for each renewal of packing the pump worked harder than ever.

Pump valves and check valves were carefully examined, but nothing was found amiss, except the remains of the packing. At length the trouble became more serious and it became difficult to keep enough water in the boiler.

Finally the problem was solved. The feed pipe entering the boiler was carried 5 feet inside the shell before discharging. Just outside the boiler head, an angle valve was placed to facilitate cleaning this pipe. When the bonnet was removed the 1½-inch pipe was found so badly scaled as to be reduced to ¼ inch in size.

After reaming out this feed pipe, first with a ¼-inch, then a ½-inch and finally with a 1-inch pipe with teeth filed in the end, the pump was started up and worked as smoothly as could be desired.

After this experience a special point was made at boiler-cleaning time to investigate such feed pipes and also the connections to the gage glasses.

F. H. STACEY.

Montreal, Can.

Water Coils Burn Out

What causes my 2-inch hot-water coils to burn out, and how can I remedy the trouble?

Boiler tubes, ten in number, connected with long return cast-iron ells, extend from the rear of the setting to the bridgewall, which is on a level with two courses of brick, which rest on bars, placed 32 inches from the boiler shell. The grating and bridgewall measure 5½ feet over all by 6 feet wide. The distance between the boiler shell and coil is 4½ feet.

In about four months, these coils turn up at the furnace end of the combustion chamber, the bend extending back about 3 feet.

I am not bothered with scale. I burn oil and the burners are set 2 inches above the brick, or 30 inches from the boiler shell.

The flame takes a straight line to the end of the bridgewall, and then leads up slightly to the boiler.

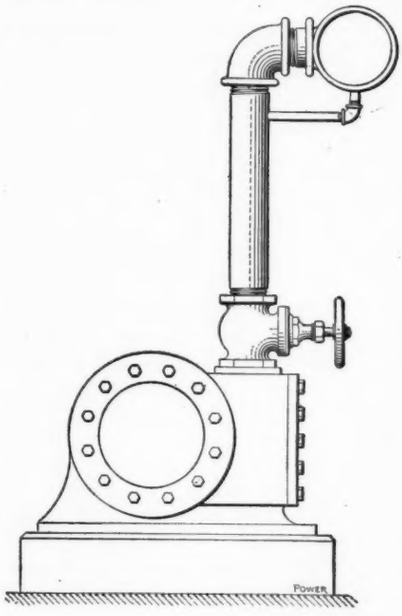
Water enters these coils from the boiler-feed pump at about 120 degrees Fahrenheit, thence to the boiler. Do these coils increase the efficiency or capacity of boiler, or both? I would like to hear from those who have had experience with coils placed beneath their boilers, in the furnace, and what advantage they have, if any, over other ways of heating the feed water.

R. A. BOOTH.

Riverside, Cal.

Steam Pipe Drips

Drips for steam mains are often neglected, and the direct drain, as shown in the accompanying sketch, is as good and safe as any plan that can be adopted. This type of drain will carry the water directly into the steam pipes leading to the



DRAINING STEAM LINE TO ENGINE CYLINDER

cylinder and consequently will drain off the condensed water above the throttle before the engine is started. This eliminates the danger of an accident to the engine. Connecting all leads to a main drip line to which many drains are led, is bad practice, as in some cases a trap is depended on to carry the extra condensation away and if it fails to operate will allow a charge of water to come over into the engine cylinder and wreck it.

When drains are carried away from the steam line leading to the engine it is best to have individual traps to carry away the surplus water rather than one trap to care for a whole line.

C. R. MCGAHEY.

Baltimore, Md.

Firing a Boiler

Most boiler attendants recognize in a general way that the economical working of a boiler furnace depends largely on the way in which the air supply is distributed and regulated and endeavor to do the best they can to comply with proper combustion conditions, but few of them can give an intelligent reason for the procedure they adopt. But a small proportion of engineers secure the best attainable furnace results and in a great many cases the matter is so imperfectly understood that there is a serious waste of fuel.

The total amount of air required for the proper combustion of fuel in a boiler furnace depends on the nature of the fuel used. With ordinary coal the theoretical minimum quantity required for combustion is about 11 pounds of air per pound of coal, but because the film of gases escaping from a burning surface interferes with the access of the fresh-air supply, it is impossible to burn a pound of coal with anything approaching so small an amount; consequently 19 to 22 pounds of air represents more approximately the quantity used under ordinary conditions, or between 8 and 11 pounds more than theoretically required. As this large quantity of air is finally expelled into the atmosphere at the chimney temperature it is desirable to keep the air supplied as low as is consistent with the efficiency of combustion. With badly designed or inefficiently worked furnaces as much as 25 pounds to 30 pounds of air is not infrequently passed through the furnace for every pound of coal burned, a fact which serves to illustrate the possibilities of economy or extravagance in connection with air distribution and regulation.

The great bulk of the air supply is drawn through the grates and the rate of flow is determined by the thickness of the fire and the draft, which is generally controlled by a damper. Under ordinary conditions the thickness of the fire does not vary very much and the air supply, if the dampers are not moved, is reasonably constant.

When the furnace receives a fresh charge of bituminous coal, the volatile gases are at first driven off very rapidly and, therefore, require a corresponding increase in the air supply just as the air flow through the grates is diminished, due to the thicker bed formed by the fresh fuel. In order to supply the necessary air the furnace doors are generally fitted with openings which the fireman can open or close at will, and in many cases the bridgewall is also arranged to admit a supplementary air supply by means of a damper operated from the furnace front.

In the hands of a skilled man the manipulation of these appliances can be made to materially contribute to the efficiency and economy of the boiler. Very

often, however, the appliances are used in either an imperfect manner or are so neglected as to be almost unworkable.

Frequently the bridgewall-damper connection is so disabled that the air orifices are either permanently stuck open or closed. Air admitted through the fire door serves to better advantage than when admitted through the bridgewall because it passes the length of the furnace before mingling with the gases liberated from the fuel. Some designs of furnace door are fitted with a box from whence the air emerges into the furnace as a spray through a perforated baffle plate. Frequently these plates are removed, or burnt away with the result that the air supply is not well distributed. After the fires have been charged the ventilating grids should be opened wide and allowed to remain so for a minute or two, the length of time depending on the character of the coal and determined by the fireman from his observations of the fire and the chimney, or better still from the readings of the CO_2 recorder.

Manchester, Eng. J. F. CRUSLAND.

Bonus System in the Fireroom

The efficiency of the human machine has a greater effect upon the profits of a power plant than is thought to be the case by many engineers and, in many cases, a greater saving may be made by increasing the efficiency of the men employed in a plant than could be accomplished by increasing the efficiency of the machinery.

This point is well illustrated by an experience I had in the plant of which I am chief engineer. Oil is burned as a fuel and two Mexican firemen attend to the boilers. Let me say right here that a careless fireman can waste dollars mighty fast, when burning liquid fuel. My hardest proposition was to get the firemen to do their work properly, as their only thoughts seemed to be of their *señoritas* and the next *baille*.

Some months ago I decided to try the bonus system and so offered to each man a 5 per cent. bonus of the fuel he could save over a certain specified amount. The effect was magical. The men are "on their toes" all the time and I never have to call their attention to the water level in heater or boilers, or to the condition of the fire. Each man received $3.75 bonus the first month, $2.50 the second, $3.30 the third and $7.80 the fourth month. The plant was only running half time the first three months and from all indications the bonus of each fireman will be from $7 to $10 per month in the future.

Result: In four months each man received $17.35 extra pay, and the *fuel account was benefited by a saving of* $312.30, which was *all "velvet,"* as no money had been invested by the company to accomplish the saving. The firemen are continually coming to me and, in their broken English, suggesting some new idea for saving fuel. When their suggestions are at all reasonable they are carried out at once and their interest is kept alive.

After this experience I firmly believe that this is the only way to "handle" firemen. It is simply a case of deciding whether the money is to be given to the fuel dealer, or divided between the firemen and the company.

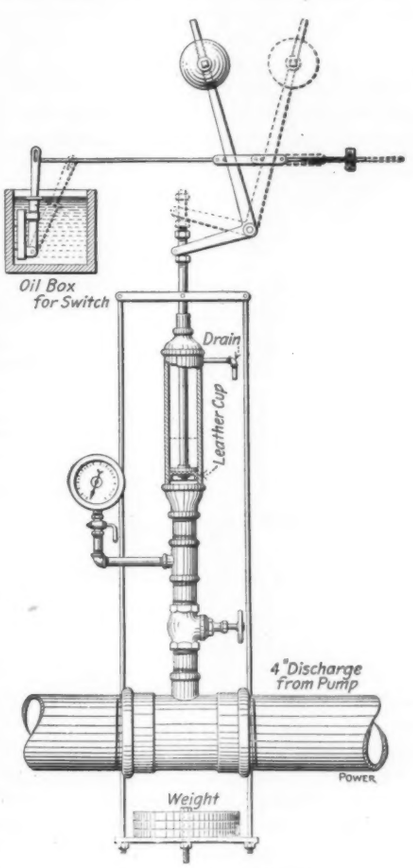
If a man is paid barely enough to keep body and soul together, he will do just as little work as he can and hold his job. If he is getting a good living wage and on top of that is receiving a share in the saving he makes, the chief engineer will soon be saying, "I have the best firemen that I ever saw."

T. P. WILLIAMS.

Brownsville, Texas.

Automatic Pump Control

The accompanying sketch illustrates an automatic pump control I built about one year ago. The motor-driven pump supplied water for a small village and worked against a 60-pound water pressure.



AUTOMATIC PUMP CONTROL

The illustration shows the details of construction.

D. F. AUBOM.

Glenwood Springs, Colo.

Melting Babbitted Brasses to a Bearing

The main generating unit in a small electric-light plant consisted of a high-speed engine and generator that ran at a speed of 300 revolutions per minute. The plant was operated ordinarily during the night, but at times was started up in the afternoon to furnish light for the opera-house matinee. A request was made for lights one afternoon; the engineer started up, filled the oil cups on the engine and left the plant in charge of the fireman while he went outside to do a job of wiring.

Returning to the plant about the time the show was over, the engineer found the engine room full of smoke, the engine was pounding so badly that it could be heard a block away and the fireman was frantically pouring oil on the crank pin, which had run hot, and the melted babbitt had been thrown out of the brasses.

The crank was oiled by a wiping device which would operate only with thin engine oil in the oil cup. The trouble was caused by the fireman who had made a mistake in filling the oil cup with castor oil. In one hour the engine had to be started for the night's run, and it was up to the engineer to make a quick job of babbitting the brasses. They could not be babbitted in position, so a piece of shaft was found that was about the same size as the crank pin on which the brasses were babbitted. After the brasses were replaced it was found that they made a bearing on a few of the high spots only. There was no time to spend in scraping them down, so the engineer decided to try an experiment.

Oil grooves were cut in the boxes, after which they were put in position and keyed up as tight as would allow the engine to be turned with two men pulling on the flywheels. The cylinder was then warmed up, the wiper filled with oil and the oil cup set to run a stream of oil on the pin. The engine was then brought up to speed and the crank watched closely for signs of smoke. As soon as the brasses began to smoke, the throttle was partly closed to bring the engine down to a slow speed so as to prevent the melted babbitt from "freezing" to the crank pin. Oil was poured on the brasses until they stopped smoking, when the throttle was closed. The brasses were then removed and thrown into a pail of water to cool. The babbitt was found to be melted just enough on the surface to give it a good smooth bearing on the pin. After cleaning out the oil grooves the brasses were put in position, the engine started and no trouble whatever was experienced with heating when the load came on. To scrape brasses in this way the engineer must be a good guesser.

S. KIRLIN.

New York City.

Questions Before the House

Comment, criticism, suggestions and debate upon various articles, letters and editorials which have appeared in previous issues

Size of Air Chamber

In the February 21 issue, Mr. Dew describes some trouble he has had with a pump which pounds when he starts it up.

I have had some experience with pumps pounding. Every time that a troublesome pump was started the noise would be something frightful, and it was a great relief when the pump picked up the water.

One engineer told me that the air chamber was not large enough. Another told me to set the steam valves. Every man that came along had a different remedy. But none was of any value. Finally, I repacked the water plungers with fresh packing well saturated with cylinder oil and graphite. I also packed the rods at the same time. I left the packing on the water plungers quite loose. When I turned steam on, I never saw a pump work nicer, and I was surprised to see how quickly it picked up the water.

Pumps have three places in which to look for trouble: the steam valves, the water valves and the packing. Air leaks are usually pipe troubles.

O. L. SHERMAN.

Duluth, Minn.

In regard to Mr. Dew's air-chamber problem as described in the February 21 issue, it is my opinion that there may be a small leak at the threads in the cap which allows the air to escape and the chamber to fill with water. A threaded cap should not be used on an air chamber as it is difficult to make a tight job. A screwed flange should be put on the end of the air-chamber pipe and the latter well peened. Then, a plate should be bolted to the flange with a rubber gasket between.

A long air chamber has no advantage over a short one; it is capacity that determines adaptability.

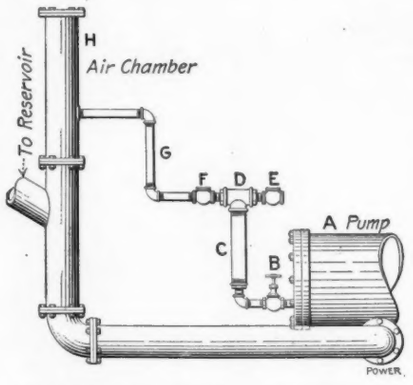
JAMES JOHNSON.

Hackett, Penn.

In reply to F. A. Dew's question in the February 21 issue regarding air chambers for pumps, I will say that the proper size of the air chamber depends upon the size of the water cylinder and not upon the discharge line, if the pump is properly installed.

For ordinary double-acting pumps working against moderate pressures, and at ordinary speeds, the cubical contents of the air chamber should be not less than three times the piston displacement. For pressures of 100 pounds per square inch or more and for high piston speeds, the capacity of the air chamber should be at least six times the volume of the piston displacement. The effect of a small inlet in the chamber would be to prevent a rapid loss of air.

Under the increased pressure in the air chamber, the air is absorbed by the water and gradually passes off with it. In this way all the air will finally pass off and the chamber will be made useless if no means are provided for renewing the supply. A simple device for maintaining the supply of air in the air chambers of large pumps is shown in the accompanying illustration. The piece *C* of 2½-inch pipe, about 25 inches long, is connected to the end of the pump cylinder *A* in a vertical position by means of a gate valve or cock *B*. The 2½-inch tee *D* is placed on the upper end of the pipe *C*. The 1¼-inch check valve *E* is placed on a nipple on the side away from the air chamber. This check valve opens inward. The 1¼-inch check valve at *F* opens outward.



ARRANGEMENT FOR REPLENISHING AIR CHAMBER

This arrangement operates as follows: When the pump is working, the valve *B* is opened. This allows the pipe *C* to fill with water. Then, *B* is partially closed until the check valves *E* and *F* begin to click. Thus, when the valve *B* is opened the pipe *C* will fill with water during the discharge stroke of the pump. As *B* is partially closed when *C* is full, the pump, during the suction stroke, will draw part of the water from *C* and air will flow in through *E* and take its place. During the next discharge stroke more water is forced into *C*, driving the air out through *F* and *G* into *H*.

If the valve *B* is open wide all the water will be drawn out of *C* during the suction stroke and cause a slapping noise in the pump cylinder, but by properly regulating the valve *B*, a column of water is kept in *C* which acts as a piston to pump air into the air chamber *H*.

A. H. STANFIELD.

Clarksville, O.

Mr. Duffy Inquires

"I am told," said Duffy, "they have made a book about that Pittsfield biler explosion. Daly says 'tis a fine book, made by the county judge."

"It is," said Doolin, "I've read it. I was over to the sugar house puttin' in tubes in the No. 18 biler an' the insurance inspector was there. He had the book in his grip an' I took it to relieve his mind from the strain of goin' through the evidence in the case. The judge is a fine man, Duffy, an' a good, plain writer. In the end ye find the pipe to the steam gage was choked wid scale an' the poor man didn't know it. With that he goes for the safety valve an' screws it down till the spring was solid an' even the huddle chamber was closed. He keeps on firin' an' chasin' B.t.u.s through the flues, worryin' all the time that he couldn't get steam enough to start. Everybody was wild to go to work an' finally some men started out to be at the ice when the engine would turn. At this instant, Duffy, the biler exploded, an' there ye are."

"Do the judge believe it was overpressure?" asked Duffy.

"There's no other cause," says Doolin, "beyond the poor man losin' his head in guessin' whether 't was the steam gage or the safety valve that wasn't right an' he has paid for that. They found the valve loaded for 225 pounds or so."

"An' I am told," remarked Duffy, "they have the best biler rules in the country up in Massachusetts. Daly says there's no doubt about it; that they have got everybody else's rules in the second division, even the U. S. G."

"Daly is right," says Doolin. "There

isn't a bilermaker but knows the Massachusetts rules is the best. An' what did ye expect else from the land of the sacred codfish an' the home of the Plymouth Rock! Sure, they know beans up there an' bilers too, for that."

"Even so," said Duffy, "the biler blew up."

"True enough," said Doolin, "but why quarrel over the rules? Mind you, those rules are new, merely a beginnin' an' a grand one, at that. Here's a terrible explosion, due to an unlooked for cause, one that had not been counted on. In a short time they will slip in a rule to cover this detail."

"An' how?" asked Duffy.

"Well, now, look at Philadelphia," was the reply. "'Tis the only place in the country where they require two safety valves on each biler. Would you believe, Duffy, if the Pittsfield man had two safety valves on his biler, that he would have took the word of the lyin' steam gage against the two valves? There is the solution of the matter. 'Tis a two to one bet I am right, as ye see. An' further, when the late George Babcock went into the biler business, he had in mind that this might occur an' so he placed two pop valves on each of his bilers. The other water-tube men, of course, did the same an' this accounts in some measure for the safety of the water-tube bilers. The next step, then, Duffy, is to pass a rule providin' for two valves set two pounds apart."

"Why not," said Duffy, "have two steam gages to each biler, one to check the other? True, in most plants ye can check the biler gage by the engine-room gage, but in the small plants, they use but the one gage."

"'Tis a grand thought," said Doolin. "If we can come back in about one hundred years an' see the bilers our gran'sons are runnin', we will see things, Duffy, that, as Bill says, are not yet conceived by mortal man. An' the Boston rules, Duffy, are doin' a great work in hastenin' the day when biler explosions will be confined entirely to the movin'-picture business. Every kicker on present conditions, every crank that takes a whack at lap-seam bilers an' lap-welded water tubes, every dreamer of a nonexplosive biler, is each mother's son a booster for better conditions an' better bilers. An' mind ye, Duffy, that Massachusetts is settin' the pace for the other States. The yeast is working an' the ferment is spreadin'. The engineers are thinkin' an' the bilermakers studyin'. The buyer in Iowa wants Massachusetts standard bilers. When, Duffy, ye get the men from the alfalfa district in line with the lads in the big cities an' then have the various societies devoted to steam engineerin', bilermakin', etc., leave, for the time bein', the discussion of who will be the next President of this bunch, an' get together for laws on biler construction, inspection and operation, ye will see every State with laws matchin' Massachusetts. In the end, Duffy, the bilermaker, the engineer, the owner and society will be benefited financially by the rigid enforcement of such laws. An' the time will come when they will take a visitor from a foreign land to a museum an' show him a lap-seam biler stuck up by a waxwork of Napoleon, Jawn L. an' other curiosities."

"An' when," asked Duffy, "will all this be?"

"I dinnaw," said Doolin. "It's up to the readers of POWER."

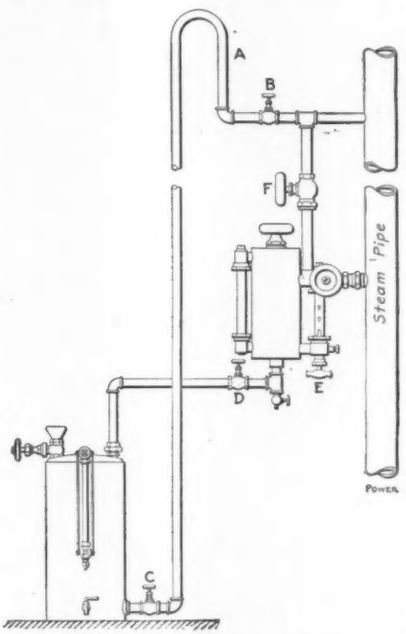
DANNY HOGAN.

Punxsutawney, Penn.

Lubricator Piping Layout

In the February 21 issue, Mr. Pierce asks for a method of piping a lubricator to a reservoir. The accompanying figure shows a good method.

The reservoir can be placed anywhere



OIL RESERVOIR AND PIPE CONNECTIONS

that is convenient for filling so long as it is in no danger of freezing. The reservoir must be below the lubricator so that no water or air will be trapped. The steam pipe *A*, leading to the bottom of the reservoir, should be fairly high (20 feet is not any too much). This hight can be gained by forming a loop as shown. This will give the necessary hydrostatic pressure.

The operation is extremely simple. When using the reservoir, open valves *B*, *C* and *D* and regulate the oil feed with valve *E*.

When using the lubricator alone simply close valves *B* and *D* and open valve *F*.

When filling the reservoir close valves *C* and *D* and drain off the water through the pet cock on the bottom of tank. When the water is all out close the pet cock and fill the reservoir through the funnel and strainer on top.

GEORGE H. HANDLEY.

Newburgh, N. Y.

Other contributions on this subject were received from James Bennett, Marshfield, Ore.; G. H. Wallace, Racine, Wis., and John A. Wise, Jamestown, O. These letters were much the same as the present contribution and the one published in last week's issue.

Slipping Latch Blocks

In the February 28 issue, I noticed Mr. Greer's account of his experience with latch blocks slipping and his remedy.

I have had considerable trouble myself with latch blocks slipping and wearing off at the edge. Instead of buying Novo steel and paying a dollar per pound for it, I used the common soft steel and case-hardened the plates. This method has proved to be very satisfactory.

I am using such plates on a 20 and 30 by 48-inch engine running at 95 revolutions per minute, sixteen hours per day. One set of plates has been on for eighteen months and when recently they were changed they were but very little worn.

J. R. WAMPLER.

Staunton, Va.

Leakage through a Piston Valve

The tests taken by Mr. Mitchell and published in POWER last October are valuable as they opened up a discussion on a subject which is of the greatest importance to both engine builders and buyers. This discussion seems likely to bring us nearer the truth as to the relative merits of the many types of valve at present in use.

Although these tests did not approach the accuracy of the Callender and Nicolson experiments, the results very approximately conform to the law of leakage which was established by those experimenters.

The suggestions in the letter on this subject in POWER of February 7 are sound and tests taken under these conditions should, without doubt, be readily accepted. One of the great objections to Mr. Mitchell's tests, which was not pointed out, however, is that the valve ran out of its liner, thus leaving only a narrow face for steam to leak past when the valve was at the end of its travel. This objection would be overcome by following the above mentioned suggestions.

The experiments of Messrs. Ide & Sons, described in POWER for November 8, are a striking confirmation of Messrs. Callender and Nicolson's statement that

minute differences of fit of a valve do not appear to affect the amount of steam leakage past the valve to any appreciable extent, and are also a confirmation of tests taken by myself to determine the advantage of ring valves over solid valves. The results of the tests which are given by Mr. Allen in POWER for November 29 show that the leakage of a piston valve does not appear to increase much even after several years' running, thus showing that the slight wear which is bound to occur is not sufficient to make any appreciable difference in the amount of the leakage. Mr. Allen champions the piston valve and gives a category of its virtues; however, the results of the tests that he gives are slightly worse than those obtained with slide-valve and rider-valve engines in this country.

Mr. Shoemaker's letter in the January 3 issue calls for much comment. His explanations of the objections to a standing test for leakage, and of the cause of the greater leakage with valves than with pistons are certainly novel and his assertions are surprising.

To test a valve he placed it in its mid-position and turned steam on. Of course, the valve leaked badly as it had very little cover and, hence, the steam had practically no distance to leak through in order to get into the cylinder. Thus, it is not surprising that in not one of more than fifty tests was it possible to open the stop valve fully.

Let him put the valve so that it is neither over the port nor partly out of its liner, then he will obtain a very different result and one which more nearly conforms to the working conditions of the valve.

The arguments that the spectators advanced against the reliability of the tests that they were shown is just the one that is advanced, and is accepted by all engineers who consider the subject, to show why the valve does not leak to any extent when standing, although it leaks considerably when running. As he pointed out, Mr. Mitchell's tests prove that the spectators had got the wrong idea. It is stated that there was no noticeable difference between the leakage with solid valves and that with ring valves; of course there was not, because the steam in all probability had no ring to get past in the latter valves and, therefore, the leakage should be identical. Mr. Shoemaker states, "We have all heard the argument that the rings in a piston do not show excessive leakage; therefore, why should the rings in a piston valve show any more leakage? The answer to this argument is simple." It is, and surely he does not think that the answer he gives is believed by anybody beside himself. From his letter I should judge that he has seen several valves, but has he not come across any that have been working for several years in the same liners?

The information on the reputed test at Cornell University, where the piston-valve rings had to be reëxpanded after three and a half hours' run because the leakage became so great, leaves us wondering how the leakage was discovered and what the mechanical efficiency of the engine was while it was grinding the valve away so rapidly. The statement that the wear on a piston valve after a year's run will be ten thousandths of an inch or more is decidedly inaccurate if the valve has been properly designed, for there are solid valves that have been running several years that have not as much clearance as this. In this country the restrained ring type of valve is largely used, and from personal observation I can say that the wear of the rings is only about four to six thousandths of an inch in a year; in fact, some rings have run a year without wearing down to the diameter of the valve body.

Mr. Shoemaker's observations on the leakage in the slide-valve engine fitted with a pressure plate is in accordance with the results obtained by Messrs. Callender and Nicolson, and it was to be expected that it would be greater than with the piston valve as there is a greater surface over which leakage could occur. I would commend to the attention of Mr. Shoemaker the carefully conducted tests of these experimenters for consideration before he makes such emphatic statements regarding the much greater leakage of the valve after a few weeks' run; apparently he has been anxious to obtain such tests to disprove arguments that have been brought forth that both of the types of valve above mentioned do not leak steam under operating conditions, but whoever brought forward any such arguments plainly showed that he had no knowledge of the subject.

Engineers will agree with Mr. McGahey in his opening remarks upon this subject given in POWER for January 17. Material, workmanship, and care in operation are three most essential considerations in the life and efficiency of a valve, as they are in all engineering work. Engine builders do not, as he suggests, make their piston valves on the expansion principle because they have no faith in their claims that such valves are steam tight, that is, comparatively speaking, but they make them in such a manner because it is realized that some wear must occur and means for taking up this wear should be provided. In the balanced slide-valve engines the wear of the valve has been minimized by the addition of a pressure plate. This plate relieves the working face of the valve from the pressure that would be exerted on it by the steam pressure on the back of the valve and, therefore, the wear is diminished; but this gives more surface for steam leakage, so the attempt to reduce the wear on the valve is not conducive to the attainment of a tighter valve. With a pressure-plate valve it is most essential to the economy of the engine that the wear which occurs should not be allowed to become excessive; because of the greater surface for steam leakage the wear will have a more harmful effect with this valve than with a piston valve.

Mr. McGahey states that he has never been able to see but one advantage that the piston valve possesses; that is, that it runs light and is light on the governor. He overlooks the advantage of not having the piston-rod glands exposed to high-pressure steam and if he had had much experience with superheated steam he would realize the great advantage of using the piston valve instead of the slide valve for high temperatures. He recommends testing the valves for leakage in the same manner as that adopted by Mr. Shoemaker, but I would again point out that this is not representative of the actual conditions of operation and that a fairer test would be to test one end of the valve at a time with its face completely covered by the liner. Mr. Mitchell's tests were conducted on these lines, as also were those of Messrs. Callender and Nicolson.

This discussion has plainly shown the great need of further experiments. The attention which it has attracted shows the interest taken in this important matter. If one or two engineering colleges could carry out a series of tests on different valves it is possible that we should then have definite information regarding the comparative leakage of the valves and this would be of great value to engineers.

JAMES CANNELL.

Stanford le Hope, England.

Water Hammer and Other Phenomena

Of the "Topics for Discussion" in the March 7 issue by John W. Payler the first one, relating to water hammer and its possible causes, has been discussed times innumerable. Two of the theories which receive almost universal acceptance are: Water lying in the steam pipe is picked up by the inrushing steam and hurled violently against the end of the pipe, a bend in the pipe or a stop valve. Second, the steam on coming in contact with the cold water in the pipe condenses, forming a vacuum into which the steam and water are projected with violent force. I accept the former as the correct one. It is beyond dispute that water will condense in a pipe and stay there unless there be an efficient draining system or the steam line be slanted toward the engine to carry it off. If the water is not drained off the steam will throw it against the first obstruction, causing water hammer.

The correctness of this assertion seems to be borne out by various observations. Take the injector, for instance: a jet of steam will pick up a stream of water and force it into a boiler against much higher pressure. If the feed valve be closed suddenly while the injector is in operation or if it be left shut before starting the

injector, a water hammer will occur, especially if the feed pipe be a large-sized one or the injector be located at a distance from the boiler.

The vacuum theory does not appeal to me because even if it were possible to create vacuum in a pipe which is presumably full of air, the only result would be an increase in the effective boiler pressure; otherwise the conditions would be the same.

As to whether water hammer is due to the contact of cold air with the inrushing steam, I will relate an experience which I had which bears on this point. I was running an air-compressor plant and dynamo for a constructing company. We ran from 2 a.m. to 6 p.m., excepting Sundays. One Monday morning I arrived at the plant, as usual, in time to warm up the engines, etc. The fireman was supposed to get there about four hours ahead of me to raise steam. On the previous day I had one of the boilers cut out for cleaning, the other one being banked. There was only one steam gage; it was connected to the steam line and there was no way of ascertaining the pressure on the boiler in which steam was being raised. The method which I usually employed was to "crack" the stop valve and give time for the pressure to equalize.

On this particular morning, there was about 75 pounds pressure on the one boiler and a very good fire under the other one. The fireman assured me that he had the fire going for at least four hours. I "cracked" the valve and later on opened it full without its giving a sign that everything was not in order. Then, I started the dynamo. In less than a minute a great rumbling sound issued from the boiler room. The sound was much like thunder and unlike what we call water hammer. Water hammer, judging from personal observation, has a distinct direction of motion. In this case there was no such thing discernible. As I rushed into the boiler room it occurred to me that there must be air confined in the boiler that I had just cut in and, although the boiler did not give a sign while the steam was at rest, it began to grumble as soon as the dynamo engine began to draw steam and the cold air to mix with the steam. I mounted the ladder to shut the stop valve, while the boiler was bucking like an unbroken bronco. As soon as the valve was closed the commotion ceased. Meanwhile, the pressure dropped to 30 pounds. The fireman corroborated my suspicions that he had got there only half an hour ahead of me and had just started the fire; consequently the boiler had just begun to get warm.

After straightening things out, I began to philosophize upon what I had just gone through. Why did not the air assert itself when I connected the boiler on which there was no pressure to the one in which there was 75 pounds pressure? I tried to satisfy this question by the theory that air being a very bad conductor objected to being heated. On second thought, this did not seem satisfactory as, after all, heating anything, no matter how bad a conductor, merely is transferring and not expending energy; the commotion that went on in the boiler required a whole lot of energy. I came to the final conclusion that heat transferred gradually will not cause any rumbling or knocking but when attempted suddenly, it will. For instance, a piece of red-hot iron when immersed in a vessel of water will cause rumbling and the water to shoot in all directions, although, if the number of heat units required to heat the piece of iron be applied to the same amount of water gradually, no disturbance would occur.

As to the second question, "Does air in pipes act as in the air chamber of a high-pressure pump, until equilibrium of temperature is established between it and the steam?" I would reply that it does. I have on several occasions raised steam in boilers without letting the air escape, to try the conductivity of the air. I let the boiler warm up until the gage showed about 15 pounds pressure, kept the pressure there for about 6 hours, then I closed the water valve on the water column and opened the blow-down valve. Air would rush out perfectly cool until the pressure dropped to about one pound and steam began to escape. This showed conclusively that cold air will not mix with steam while at rest and that it will not be heated by conduction; at least, not very quickly. Of course, if circulation be established, it would receive heat quite rapidly.

The third question was: "Is steam formed under or above the surface of the water?" I cannot conceive of steam forming "above" the surface. What is to become of the space between the surface of the water and "above"? The water nearest the heating surface receives heat first. In receiving the heat it expands and rushes to the surface, establishing circulation. This is continued as long as heat is applied. Water, like anything else, is subject to the laws of gravity. The hottest water, being the lightest, always rushes to the surface where, I should say, steam is formed. This seems to be true with the exception of cases where defective circulation exists, when steam is formed at the heating surface. This condition is manifested by priming or a violent motion of the water level in the gage glass.

The fourth question was: "How, and by what means, is a very rapid production of a large volume of steam produced after a violent and destructive boiler explosion?" If in a boiler carrying, say, 90 pounds pressure and containing one ton of water, a sudden reduction of pressure takes place, caused by the opening of a stop valve or a rupture of a defective plate, a corresponding drop in the temperature will result, liberating, per pound of water contained in the boiler, 108 B.t.u. which would instantly be available to turn some of the water into steam. This sudden formation of a large quantity of steam would hurl the water surrounding it against the shell, causing a violent and destructive explosion.

VICTOR BONN.

New York City.

The Benefit of Organization

I read POWER—have read it ever since 1887—and have distributed many copies of it through the State in which I live. I have seen it make many good engineers by a careful study of the experiences of other engineers. But I must differ with Mr. Gotstein in the March 14 issue.

Organization will not secure more salary; the engineer's work is different from any other calling or trade; he is appreciated for just what he is worth. His value is estimated not from the amount of laborious work he does, but from the money he saves in the plant's operation.

His end of the establishment is often the maker or breaker of the firm's financial standing; often either bankrupts or saves money, depending on whether he is what his name and calling indicate or simply a coal passer and oiler—a stopper and starter.

When any man gets the idea in his head, as evinced in Mr. Gotstein's letter, that he is worth more money than his employer pays him, let him get out; if he is competent and muscular enough to perform the work and has the abilities to keep up a better establishment—there are other places. Men of abilities are always wanted, and the pay is proportioned to the abilities displayed.

I know of a man that believed he was worth more than his firm paid him; he said so; he sought another position; he did not seek long; he is drawing $6000 a year today.

I know of many who are drawing good salaries. I have seen men in organizations cut wages more than any other men. It was each for himself and "the devil take the endmost."

My forty years' of experience has taught me to lead up, look up, help up, to learn all that one can and one will earn more and positions will come his way without depending on organizations. He best helps himself who leads another up!

T. D. WALLACE.

Duluth, Minn.

"What did you do with the steam gage?" asked the superintendent of the lumber mill.

"Oh!" replied the darky engineer, "Do you mean that thar ole clock? I takened it off, an' thowed it away. It won't keep time no how."

Inquiries of General Interest

Questions are not answered unless accompanied by the name and address of the inquirer. This page is for you when stuck—use it

Split Condenser Tube

If a tube in a surface condenser should split, how could it be temporarily repaired so as to keep on running?

S. C. T.

A surface condenser tube may be cut out of service by stopping the ends with soft-wood plugs. The splitting of a single tube would not have any appreciable effect on the operation of the condenser or on the vacuum.

Bare Tube Sheet

Why can the upper tube sheet of a vertical boiler be left bare without the danger of burning?

B. T. S.

Because the hot gases in passing through the lower part of the tubes give up so much heat that they cannot overheat the upper portion of the tubes and the head to the danger point.

Saturated and Superheated Steam

What is the difference between saturated steam and superheated steam?

D. W. S.

Saturated steam of a given pressure has the temperature at which water will boil under that pressure. It may be moist, may carry unevaporated water along with it as mist in which case its quality is designated by the percentage of the mixture which is steam. Thus steam containing 2 per cent. moisture and having the temperature at which water boils under its pressure is "saturated" steam having the quality 0.98. When the last trace of moisture is dried out the steam is "dry saturated." Further application of heat will raise the temperature of the steam above that due to its pressure when it is said to be "superheated." If moisture is introduced into superheated steam, the superheat (that is to say, the heat above that necessary to make it dry saturated) will be taken up by the water, so that normally superheated steam will be dry.

Temperature and Pressure

Are there other means than the steam gage and safety valve for determining the pressure in a boiler?

F. F. P.

Yes, a thermometer may be used.

Effect of Rocker on Eccentric

What effect has a rocker on the setting of the eccentric?

E. R. E.

It changes the position of the eccentric with regard to the crank. Without a rocker the eccentric leads the crank; with one it follows it.

Effect of Broken Spring

If the spring in a centrifugal governor should break, what effect would it have on the speed of the engine?

E. B. S.

The centrifugal effort of the weight is opposed by the tension of the spring. If this tension is removed by breakage or otherwise the weight will move outward and reduce the speed of the engine.

Location of Lap Crack

Where should search be made for a lap crack in a horizontal tubular boiler?

P. L. C.

A lap crack usually occurs in the outer or overlapping sheet near the row of rivet heads. It is covered by the inside lap and cannot be seen until it extends through the plate. Search will not reveal it as it can be found only by unmaking the joint.

Morrison Flue Collapsing Pressure

What is a Morrison furnace flue? Give the rule for determining the allowable pressure, and the rule for determining allowable pressure on riveted boiler flues.

M. A. D.

A Morrison furnace flue is one with consecutive annular corrugations throughout its length.

For corrugations 1½ inches deep the pressure of collapse is found by the formula

$$\frac{t^2 \times 1200}{D \times \sqrt{L}} = p$$

in which

t = Thickness of tube in thirty-seconds of an inch;
D = Greatest external diameter in inches;
L = Length of tube in inches;
p = Pressure in pounds per square inch.

For the strength of butt-strapped flue joints the English Board of Trade prescribes the formula

$$\frac{90{,}000\, t^2}{(L+1)\, d} = p$$

and for lap-riveted joints

$$\frac{60{,}000\, t^2}{(L+1)\, d} = p$$

in which

p = Collapsing pressure in pounds per square inch;
L = Length in feet;
d = Diameter in inches;
t = Thickness of plate in inches.

Latent Heat

What is latent heat?

L. H. S.

It is heat that is absorbed by a substance when changing from one form to another without any increase in temperature, as when ice changes to water or water to steam.

Boiling Point of Watar

Is it possible to heat water above 212 degrees at atmospheric pressure?

B. P. W.

If water is entirely freed from all dissolved air it may be heated to about 260 degrees before ebullition takes place. It then flashes into steam with an explosive effect, which fact has been used in some instances in attempts to account for certain boiler explosions.

Piston and Cylinder Clearance

What is meant by piston clearance in a steam engine?

C. C. P.

Clearance in a steam-engine cylinder means all of the space not swept through by the piston. With the piston at the end of the stroke, the space between the cylinder head and the face of the piston and the volume of the ports constitutes the clearance. It is reckoned in terms of percentage of the piston displacement. The term piston clearance is sometimes used in reference to the distance between the piston and cylinder head when the engine is on the center.

Full-weight standard pipe should be used for pressures up to 125 pounds, and full-weight extra-heavy pipe for pressures above 125 pounds. Cast-iron standard fittings should be used only for pressures below 100 pounds, medium extra heavy for pressures from 100 pounds to 150 pounds, and extra heavy over 150 pounds.—*Ex.*

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POWER

The Control of the Coal Supply

The power-plant owner will sit up nights to figure how he can save ten per cent. in the cost of power production. He will invest money in expensive engines and search for boilers of the maximum efficiency; he will buy indicators and CO_2 recorders and strive to save the last redeemable fraction of a pound of coal per horsepower or kilowatt-hour.

And then he will sit supinely by and see a group of men grab all the coal in sight, and watch its price go up to "what the traffic will bear."

We will not presume to assert that the beneficent storing of the energy radiated to and absorbed by the earth in past ages was designed for the benefit of all mankind, but we think that the fact is sufficiently evident that the many would have profited at the expense of the few if the founders of the Republic had had such a prevision of the coming importance of the coal deposits to the industries of the country as to have kept their ownership and control in the hands of the people.

What has been done is done, and the growing conflict between the rights of property and the rights of man must drag out its slow and toilsome course. But we can stop piling error upon error and sacrifice upon sacrifice. All of the coal and oil and mineral wealth has not been ceded, and the people, through the national and State governments, still retain control of much of the undeveloped water power. A few earnest far-seeing men are trying to call a halt upon the wholesale surrender for all eternity of this control and of the rights of the people in their inheritance. Have you attached any more than a political significance to their effort? Have you done anything to hold up their hands? Have you manifested any disapproval when those in high places have blocked their progress, kept alive the hopes and encouraged the machinations of the grabbers?

The far-seeing business man, the educated and thinking engineer, can realize the possibilities of the next half century in this direction as few legislators can. A general attitude of protest upon their part against the continued giving away of the people's property to individuals that they may sell it back to the people at baron-making profits will make their representatives think twice before continuing the process of public depletion and private enrichment. An attitude of openly expressed approval of the efforts of those who are working for new and better ideals and practices in this respect will encourage those who are giving of their time and effort and money for the general good, and discourage those who are reaching after the public property for their individual gain, and the officials who are inclined to help them to get it.

Place the Responsibility

In the matter of boiler explosions, which are rare in England as compared with the United States, a very different course is pursued from that in vogue here. Whenever a power-plant accident occurs the owner is held accountable and primarily responsible until an investigation by the commission of the Board of Trade places the responsibility and fixes the punishment. In this country it seems that the effort on the part of those chosen to fix the responsibility is, if possible, to find someone who was killed on whom the blame can be placed. This, if successful, is usually followed by a "whitewash" of those who may possibly be considered by the public to be even remotely connected with the accident, and the incident is closed.

Last summer a thermal-storage tank in a south of England city failed along the head flange, killing two men and doing considerable property damage. The investigation which was conducted by the engineers selected by the commission revealed the fact that the head plate was cracked by the use of a hydraulic riveter in forcing the cold head-plate flange and the shell together. When the evidence was all in, the commission which sat on the case assessed a fine of two thousand dollars against the company that built the tank, a fine of two hundred and fifty dollars against the manager of the company for allowing the tank to go out of the works, two hundred and fifty dollars against the chief engineer of the power plant for allowing the tank to be installed and one hundred and fifty dollars against the operating engineer of the plant for not cutting out the tank when the leak was first noticed.

It would seem that such a gloveless handling of a few cases of morally criminal carelessness in this country

would have a salutory effect and perhaps tend to reduce the rate at which explosions occur. In 1909 there were five hundred and fifty. The complete reports for 1910 are not yet available but it is thought that the figures for that year will closely approach those of the one before. For the first eighteen days of 1911 there were twenty-four, which rate, if kept up for the rest of the year, will fetch the total to five hundred and forty-seven, a number far beyond the really unavoidable. If the English method had been applied to some of the recent American explosions the beneficial effect would have been felt all over the land, for not a boilermaker, owner, operator or inspector cares to go down in his pocket for funds to pay for the privilege of taking a gambler's chance on the safety of a manifestly unsafe boiler.

Preventing Power Plant Losses

The problem of keeping down the cost of operation confronts every steam-plant owner, and the methods employed in solving this problem are many.

Purchasing cheap supplies is doubtless the means most commonly used. For some reason or other, many operators seem to believe they can get as good an article cheap as they can by paying a higher price. As a result, the repair bills run up to a much higher figure than the sum saved by purchasing cheap supplies.

In other matters men use good business sense. Not one of the purchasers of cheap supplies would think of purchasing a suit of clothes for fifteen dollars and imagine that they would wear as well as a fifty-dollar suit.

Cheap oil is used and journals heat and burn out. Poor coal is put into the furnace and the fireman is blamed because he burns more coal per horsepower developed than the man across the way.

A good engineer working for a low wage can make a good fight to keep things going, but there are conditions that will get the better of him, and one way to bring them about is to supply him with inferior equipment and maintenance supplies.

Is it cheaper to put a packing in the stuffing box of an engine that will last a few weeks or to use a packing costing twice as much that will last years?

Which is the more profitable way of running an establishment: to pay out hundreds of dollars in unnecessary repairs, or to use better and more costly supplies, and avoid frequent repair bills?

How it makes the careful manager squirm to see good coal in the ash pile, yet he has no compunction against running the engine year after year with leaky piston rings and steam valves. He has no idea how much steam is leaking into the exhaust pipe without doing work. The loss is there, although it cannot be seen. And that is the point: the losses that cannot be seen are given scant attention. It is a case of "don't know, don't care." These unseen leaks cost money, however, and these invisible losses eat up profits. The visible losses generally force the management to remove the cause.

In many instances gross neglect can be seen in the management of the power plant. In one instance a steam plant furnishes steam and power for a manufacturing concern, but of all the numerous steam pipes that emit steam hardly one discharges into a trap, although such an arrangement is feasible.

Out in the yard a new Corliss engine has lain all winter exposed to the elements with no pretense of protection and there is seemingly no anxiety on the part of the owners as to its condition or to the extra expense that will doubtless be entailed in getting the engine in proper condition to run when it is finally put on its foundation in the engine room.

On the other hand, a member of this same company reported one of the engine-room attendants because he had been seen eating a portion of his lunch before lunch time—a horrible waste of time and a financial loss to the company.

Why not be consistent regarding these things? If a watch is kept to guard against the company's losses, why not make it thorough and not stop with the man eating a little lunch before time, while out in the yard an engine costing several thousands of dollars is being injured by exposure to the elements? It is better to look after the source of real losses rather than to waste time reporting petty trifles which in a year's time would not save the renowned "thirty cents."

Explosion on the "Delaware"

Elsewhere in this issue appears a summary of the findings of the board which inquired into the cause of the boiler explosion on the battleship "Delaware." There appears to be no question as to the direct cause of the explosion, as all evidence points to a condition of low water. In this type of boiler, the burning of the lower part of the rear headers would indicate that there was no water whatever in the drum; furthermore, as stated in connection with the report, that water which did flow into the boiler probably passed directly into the inboard headers and tubes. Considering the slow rate at which the boiler was steaming, it would have taken at least half an hour for the drum to have been emptied completely and the question immediately arises: What was the water tender doing all this time?

It is possible that the connections to the gage glass may have been obstructed, although an examination after the accident failed to reveal any obstructions. Even if such were the case, the gage cocks would have shown that the water was leaving the drum. We are told that the water tender was an experienced man and, as such, much confidence was placed in him; nevertheless, the boiler exploded and the water tender should have known that there was practically no water in it. Just why he was not aware of it will probably never be known, but the fact remains: Had less dependence been placed upon the human element and a low-water alarm and fusible plugs been used, it is probable that the low water would have been detected before any damage was done.

The effect of vacuum upon the steam consumption of a turbine is strikingly shown by the reports of a recent test on a one thousand-kilowatt machine in which the consumption increased forty per cent. with a decrease in vacuum from twenty-nine to twenty-one inches.

It is conceded that specialization to the exclusion of general knowledge is a bad thing; nevertheless it is always well to know a little more than the other fellow about some particular subject. This knowledge carries with it a certain amount of independence.

The easiest way to find out whether you are right or wrong is to get down to basic principles and work up from them to the question at issue without thinking about preferences, hobbies or personal interests.

The man who uses his fingers to test the possibilities of a dangling piece of insulated wire belongs in the same ward with the idiots who rock boats and point unloaded guns at people.

Gas-engine lubrication by "splash" from the crank case is in the same class with hot tube ignition, the old tallow cup on steam engines and the high-wheel bicycle.

Have you thought of the engineer as a mechanic who must know more, work longer hours, carry more responsibility, and have much more expected of him than of any other ordinary mechanic, and still get a smaller sum on pay day?

The fireman's temper is one of the best indications of the quality of the coal and the condition of the fire.

Oil is purchased by your company to lubricate bearings of various kinds, not to pour on the floor.

It's rash to wish all the fools were dead. Some of our best friends would be missing and lots of us who remained would have to move down several notches in the scale of merit.

An engineer with a chew of tobacco in his mouth and wearing a full-dress suit doesn't synchronize.

Boiler Explosion in Georgetown, S. C.

On March 4, 1911, boiler No. 3 in plant No. 1 of the Atlantic Coast Lumber Corporation at Georgetown, S. C., exploded, killing three persons and injuring four others. The boiler plant consisted of ten horizontal tubular boilers set in one battery, eight of the boilers being in the boiler house proper and the other two boilers immediately adjoining the boiler house. As a result of the explosion, the center sheet of No. 3 boiler was torn bodily from the boiler and several boilers nearby were displaced and damaged to a greater or less extent. The roof of the boiler house, which was made up of structural-iron trusses covered with corrugated iron, was almost a total ruin. Boilers Nos. 3, 4, 5 and 6 were practically ruined. The side walls of the boiler house, which was a building approximately 93x70 feet, were ruined to a greater or less extent, some of the wall being thrown down bodily, and much of the wall that remained standing must be taken down and rebuilt. A number of pumps, heaters, conveyers, engines, belting, etc., together with a very complete supply of operating materials in the engine room, were destroyed.

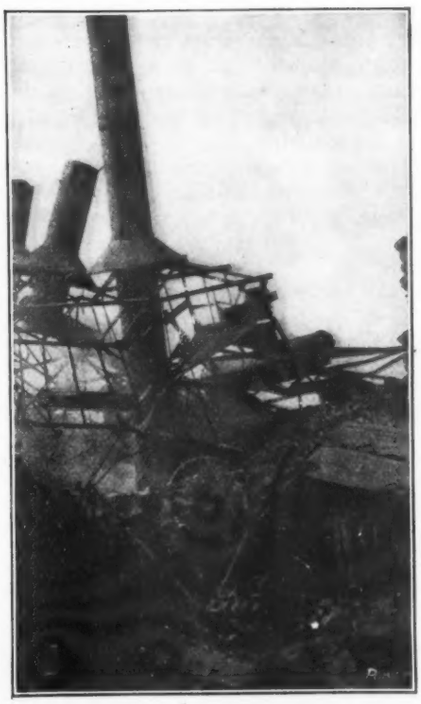


FIG. 2. DAMAGE TO STEELWORK AND STACKS

The investigation as to the cause of the explosion appeared to show, according to sworn evidence of a number of witnesses, that the stipulated pressure of 100 pounds had not been exceeded. This fact was also corroborated by the record made by the recording steam gage which showed a pressure of 98 pounds at the time of the accident. There was no evidence of burned sheets or of low water. Several pieces of the metal in the boiler were tested by being bent double while cold and showed no sign of fracture. The boiler failed at or near one of the longitudinal seams. Practically all of the fracture or break was not (as is usually the case) through rivet holes, but through the solid metal. There was, however, one section about 3 inches long, torn through the rivet holes. It is possible that there may have been a hidden crack at this point, and this appears to be the only reasonable cause of the accident. This boiler having been built in three courses with two sheets to each course, caused the longitudinal seams to be below the top of the tubes; consequently, it was practically impossible for an in-

FIG. 1. RUINS OF GEORGETOWN EXPLOSION

spector to discover a hidden crack in the seam from the inside of the boiler and it was equally impossible to discover the crack from the outside on account of the wall being close to the longitudinal seam.

All of the boilers at the plant had been internally inspected during the Christmas holidays of 1910 and inspections were carefully and conscientiously made, according to sworn statements of the chief engineer and foreman boilermaker at the plant, both of whom were with the inspector during the time the inspections were made.

The boilers were insured with the Ocean Accident and Guarantee Corporation, of 59 John street, New York City, who promptly paid $25,000 in settlement of the loss to property caused by the explosion.

Court Findings in Boiler Accident on "Delaware"

Through the courtesy of the Babcock & Wilcox Company, we are enabled to publish the accompanying summary of the finding of the court of inquiry which investigated the accident to one of the boilers of the U. S. S. "Delaware."

From the short note previously published in POWER, it may be remembered that the accident occurred about 9:15 a.m. on January 17, while the "Delaware" was bound for Norfolk, Va. The ship was proceeding under easy steam, but on account of poor draft the fire rooms were closed and working under an air pressure of ¼ inch. This, under the circumstances, was not more than good natural draft, so that the rate of combustion was about 18 pounds of coal per square foot of grate. The boiler is one of the well known Babcock & Wilcox marine type, with 4425 square feet of heating surface and 103 square feet of grate surface, there being 14 boilers in all. On trial, the "Delaware" developed nearly 30,000 horsepower, so that this boiler when worked under forced draft has a capacity of over 2000 horsepower.

The damage was confined to boiler "O" and the extent and nature thereof are set down in the findings in considerable detail. It is also to be noted that the structure of the vessel was not injured at all, thus emphasizing again the fact that an accident to a water-tube boiler involves the minimum of damage. The boiler was repaired while at Norfolk with some headers and new tubes, most of the work being done by the engineering department of the ship.

There is one point in the finding which needs just a word of explanation to make it perfectly clear. The court finds that only the outboard half of the boiler was damaged. It might seem at first glance as though it would be impossible for one-half of the boiler to be injured and the other escape. The explanation, however, is very simple. The feed water enters the boiler in the steam and water drum, which is above the front headers and connected to them by nipples, and is discharged through an internal feed pipe perforated with holes on its lower side. This pipe extends from the check valve at the inboard end of the drum to a short distance past the center of its length. As long as the water in the drum was above the tops of the nipples mentioned, it would not, of course, make any difference where the feed water was introduced, as it would naturally find its level. In case of low water, however, due to inadequate feed, there might be under moderate combustion, just enough water to save the inboard half of the boiler, where the water would go directly down the nipples, while only a few headers and associated tubes on the other side would get any. This appears to be the explanation of the salvation of the inboard side of the boiler.

With this general statement of the surrounding conditions, the finding of the court should be entirely clear, and it would seem that the court is to be congratulated on the very careful analysis which it has made of all the circumstances of the case, so that the reasons for its conclusion that the accident was due to low water are perfectly evident and convincing.

FINDING OF COURT

"In compliance with the request contained in your letter of February 24, and with the approval of the department, the bureau submits for your information the following general statement of the finding and opinion of the court of inquiry appointed to inquire into the accident to boiler 'O' of the 'Delaware':

"(*a*) An explosion occurred in boiler 'O' January 17, 1911, by which three rear headers Nos. 8, 9 and 10 were blown bodily out of the boiler.

"(*b*) These headers were found severely bowed, their tube faces were bulged, and the metal showed signs of overheating. All the back headers of the outboard half of the boiler, 13 in number, were more or less bowed, the degree of distortion diminishing toward the outboard side of the boiler.

"(*c*) The inboard half of the boiler was uninjured, and consequent comment refers only to the outboard half.

"(*d*) The 4-inch tubes next the fire were all more or less bowed near the back ends, and showed signs of having been burned; and the majority of the 2-inch tubes were more or less distorted, while a number showed signs of having been white hot.

"(*e*) The front headers were in good condition.

"(*f*) The superheater tubes and manifolds showed a red color, and the 4-inch tubes through the first and second passes showed the blue color characteristic of overheating.

"(*g*) On two of the headers blown out were found scores and dents made by the headers striking obstructions. The character of the scores and dents, and the blue color of the metal in the scores, indicated that the metal of the blown-out headers was in a softened condition, due to heat, when they struck.

"(*h*) The three headers showed unmistakable signs of having been very hot. They showed the characteristic blue color following overheating, and the tube face of each had been bulged out by internal pressure, possible only when the metal is heated to a condition approaching redness.

"(*i*) The greatest heat appeared to have existed at about the width of the hight of the header, but the effects of overheating were manifest in all the back headers of the outboard half of the boiler, diminishing either way from the zone of greatest intensity of heat, which appeared to exist opposite the headers that were blown out.

"(*j*) A number of 2-inch tubes of the blown-out headers gave evidence of having been white hot. The surface of these tubes, near the back ends, appeared burned, and was covered with a coating of black oxide of iron. Signs of overheating were also in the outboard half of the drum, from which much of the soot had been burned off.

"(*k*) From a consideration of the preceding facts, the court concluded that the explosion was due to the lack of a sufficient quantity of water in the boiler, and that the water tender on watch at the time was responsible for this condition. This opinion was strengthened by the fact that it was possible to enter the fire room with safety a very short time after the explosion occurred, which would not have been possible had the boiler contained the normal quantity of water.

"(*l*) All testimony showed that the boiler was in good condition prior to the accident, and that the regulations regarding the care and preservation of boilers had been carried out; that other boilers which had been subjected to the same use were in good condition; and that the overheating noted in the injured boiler would have produced the results observed by the court after the accident, no matter how perfect the boiler.

"(*m*) From some testimony before the court, the conclusion was reached that the reading of the water gages was misleading, although the gage glass fittings are recognized as simple and reliable; other testimony, however, led to the opinion that the opening of the feed check valve had been increased shortly before the accident occurred.

Very respectfully,

R. S. GRIFFIN,

Acting Chief of Bureau."

New Power House Equipment

What the inventor and the manufacturer are doing to save time and money in the engine room and power house. Engine room news

The Kennicott Water Weigher

A device for automatically recording the weight of water fed to boilers and correctly ascertaining the evaporation, is the Kennicott water weigher, which is manufactured by the Kennicott Company, Chicago Heights, Ill.

As shown in Fig. 1, the Kennicott water

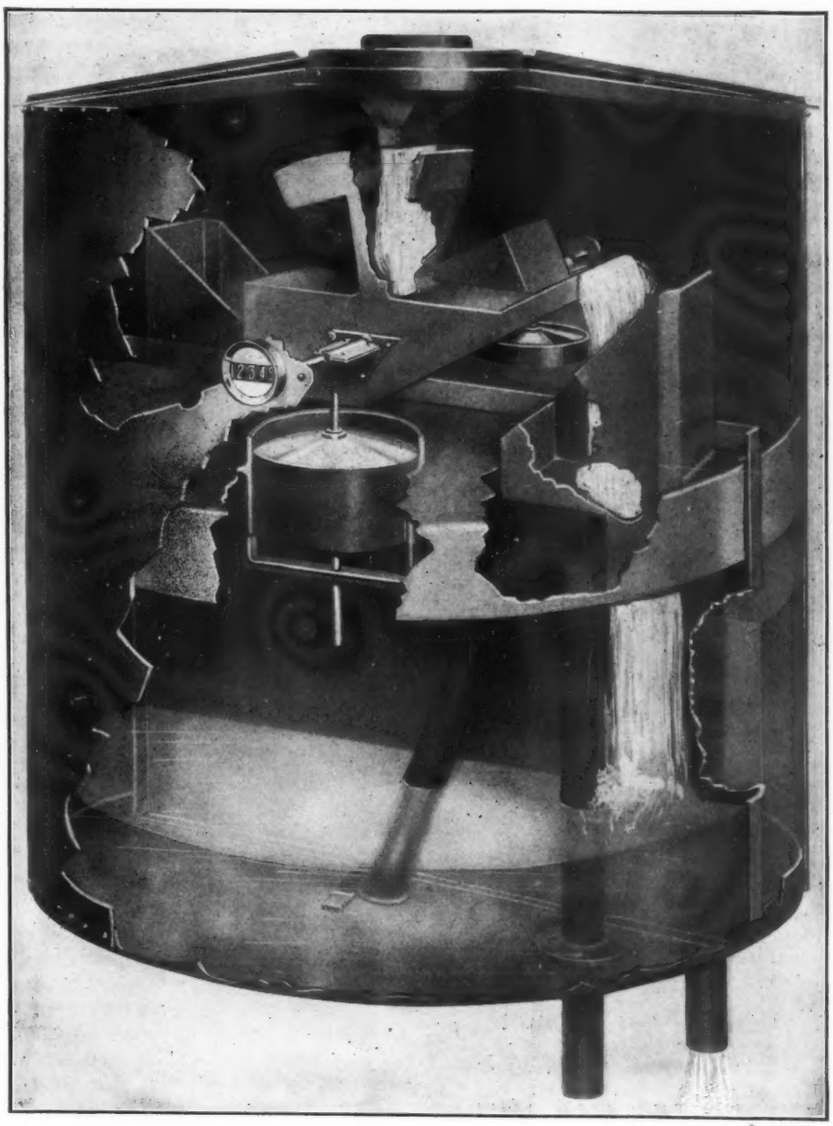


FIG. 1. VIEW SHOWING INTERIOR OF THE KENNICOTT WATER WEIGHER

weigher consists of a shell, the lower part of which is divided by a partition into two measuring or weighing compartments. A siphon in each compartment discharges the water when the full-unit charge has been received. A tipping box composed of two halves, which alternately fill with water, serves the double purpose of furnishing a sufficient quantity of water to start the siphons and to shift the supply from one compartment to the other. This tipping box is balanced on pivots, is mounted directly above the weighing compartments, and is operated by floats, one in either compartment.

Water enters the inlet and passes to the tipping box, where a small portion of it is intercepted, the remainder passing directly to the weighing compartment below. When this compartment is nearly filled, the float tilts the tipping box, thereby automatically spilling the water contained in the tipping box into the compartment, thus completing the unit charge and starting the siphon which discharges the unit charge, while the entering water passes to the opposite half of the tipping box and to the opposite compartment which fills and empties in a like manner.

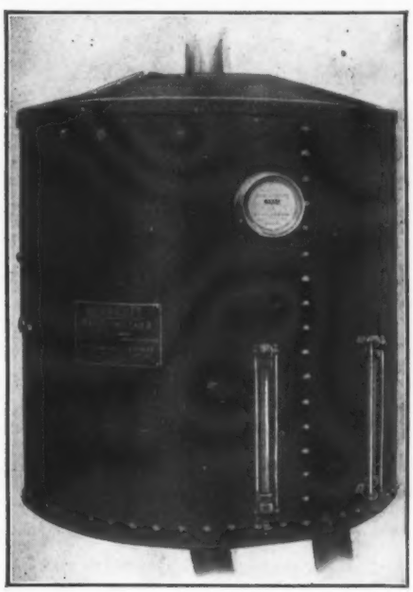


FIG. 2. WEIGHER ARRANGED TO DISCHARGE INTO STORAGE TANK

A counter registers each double unit charge developed by the weigher, and is so arranged that it cannot be tampered with by unauthorized persons.

This weigher has no valves in its mechanism to leak and cause unreliable records and it has no pistons or revolving disks.

The weigher can be placed to receive water from any source and deliver it in unit charges of uniform weight into any available storage tank or hotwell and, when weighing boiler feed water, the feed

pumps take the water from the storage tank. This arrangement is shown in Fig. 2.

This weigher is also furnished complete with storage tank and balanced pressure inlet valve, as shown in Fig. 3. The balanced pressure valve is controlled by a ball float in the storage tank which automatically regulates the supply to meet the varying demands of the plant,

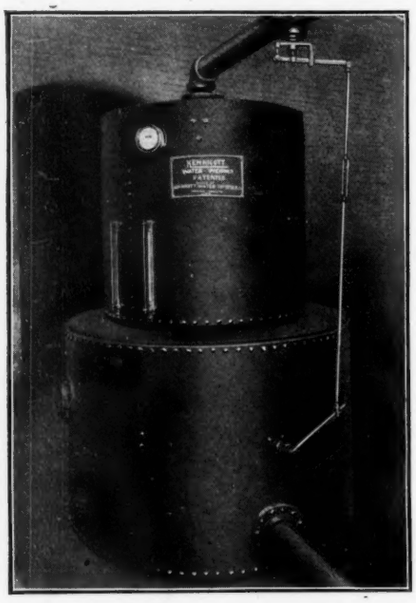


FIG. 3. WEIGHER AND ATTACHED STORAGE TANK

and insures that the storage tank is always full of water.

Each weigher receives an individual test and calibration. The unit charges are accurately weighed on platform scales, and a certificate of accuracy and capacity is sent with each shipment. The weigher is guaranteed to record the correct weight of water to within one-half of one per cent. of absolute accuracy.

Besides weighing boiler feed water, this weigher will accurately weigh or measure any free-flowing liquid, hot or cold.

Automatic Engine Stop

This mechanism has been designed to prevent flywheel accidents due to the engine racing or running away, and also enables the possessor to stop the engine from any desired point in the shop.

It consists of a valve of the Corliss type which is so balanced as to be practically frictionless. Fig. 1 shows a front head of the valve on which is mounted a solenoid, a valve lock or disengaging arm and a valve lever. Fig. 2 shows an interior view of the valve when it is in its open position. The face of the valve is turned on one center and the stem on which it rotates is offset so that the valve does not touch the face of the seat except when it is closed. By means of this eccentric motion of the valve, in relation to its seat, friction between the valve seat and face has been eliminated, and there is no chance of the valve sticking and refusing to operate. Fig. 3 shows the automatic spring-switch trip arrangement, and Fig. 4 is a wiring diagram.

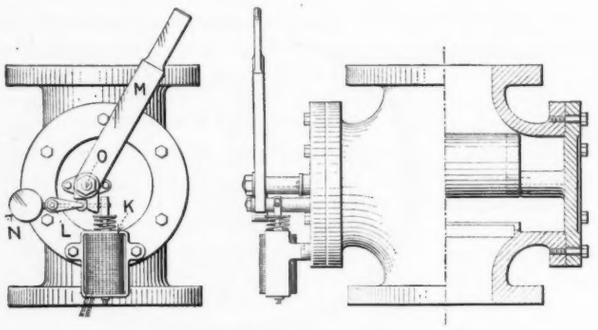


FIG. 1. END AND SIDE VIEW OF THE DETACHING DEVICE

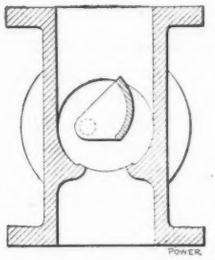


FIG. 2. SECTIONAL VIEW OF VALVE AND SEAT

Either batteries or regular line current can be used if desired.

The operation of this mechanism is as follows: *P*, Fig. 4, is the solenoid mounted on the front head of the valve; *R* is the automatic spring switch and *S S S* are shop switches for emergency use.

Referring to Fig. 3, *B* is a bracket fastened to the engine shaft *A* and supports the weight arm *C*, which turns on the pin *D*. The centrifugal force exerted by the shaft turning in the direction indicated by the arrow will throw the arm *C* out and away from the shaft. The distance this force will cause the arm to move out is regulated by the resistance of the spring *E*. At normal speed the spring is set to hold the arm *C* tight against the shaft *A*, but any increase of speed will cause the centrifugal force to overcome the spring resistance and allow the arm to move out so that the point *F* will describe a larger circle until it comes in contact with the pin *G*, forcing it down and thus releasing the spring knife switch *J*. This closes the electric circuit, as will be seen by glancing at the wiring diagram in Fig. 4.

When the circuit is closed, either by the increased speed of the engine or by throwing in one of the shop switches, the solenoid *K* is energized, which causes it to draw the plunger down, hitting the disengaging arm a hammer blow, causing it to turn on the pin *L* and disengaging the roller, shown in Fig. 1, from contact with the nose of the lever *M*. This disengaging arm is afterward brought back to its normal position by the counterweight *N*. The valve lever *M* is attached to the valve stem *O* and when one of the switches is closed the valve and lever will drop, shutting off the steam and stopping the engine.

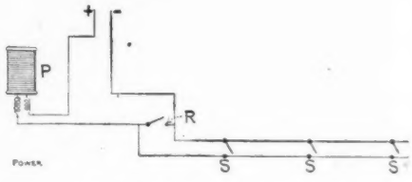


FIG. 4. DIAGRAM OF WIRING

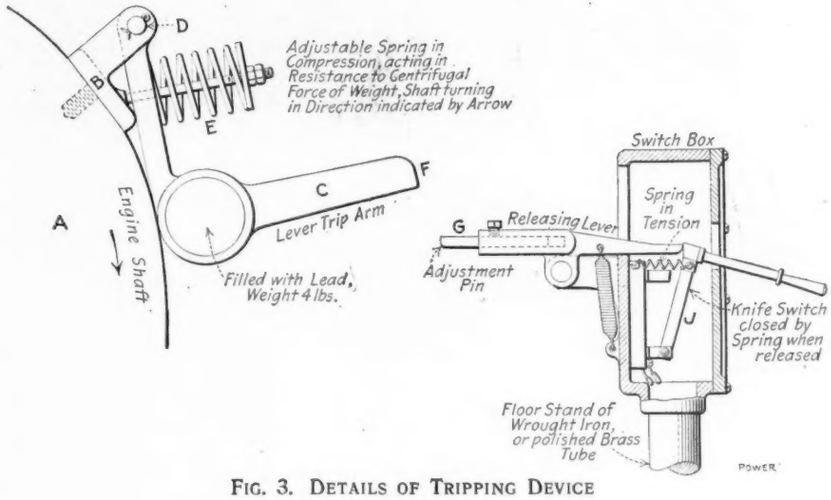


FIG. 3. DETAILS OF TRIPPING DEVICE

This apparatus is made by the Automatic Engine Stop Company, Sheboygan, Wis.

A Vacuum Ventilator

As the name implies, the principle upon which this ventilator operates is due to a vacuum formed in the hollow ball of the ventilator. This ball is placed on the top of a vertical outlet and serves the purpose of drawing out the foul air, gases, etc., from the room to which it is attached.

In operation, the wind strikes the ball, which has an opening as shown in Figs. 1 and 2. As the wind passes over this opening it sucks out the air which is in the ball and causes a partial vacuum. The air in the building or room below, being under normal pressure of the atmosphere, is forced up to take the place of that which has left the ball, the process becoming continuous, and results in a strong, steady updraft as long as there is any movement in the outside atmosphere.

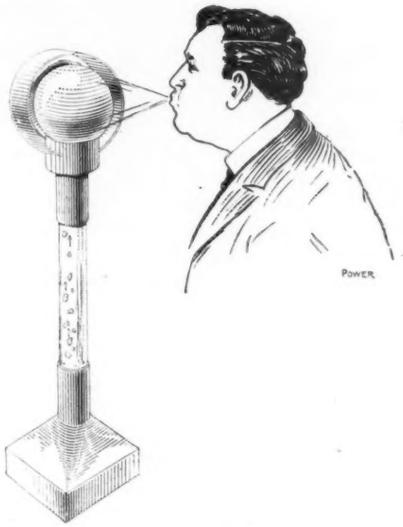


FIG. 1. HOW IT WORKS

Fig. 1 shows how this is accomplished. The wind velocity is represented by the figure. Air is blown against the ball and the particles shown in the tube between the stand and the ball represent the upward current of the air. Fig. 1 represents a model that has been made for the purpose of demonstration. A person blowing against the ball is able to draw particles of paper, fine cloth or anything that is of a light material up through the tube and out through the opening in the ventilator head.

Fig. 2 shows a sectional view of the ventilator. It will be noted that the head is made in the shape of a sphere and the rounded surface is presented to the wind no matter from what quarter it blows, and divides the current of air which passes over the outlet space with the result described.

The hood is provided with a shield which protects the vertical outlets and keeps rain and snow from getting into it and also keeps the ventilator free from downdrafts. It is so situated that the offset is enough to allow free egress of the heated air and free and easy access of the wind to the outlet.

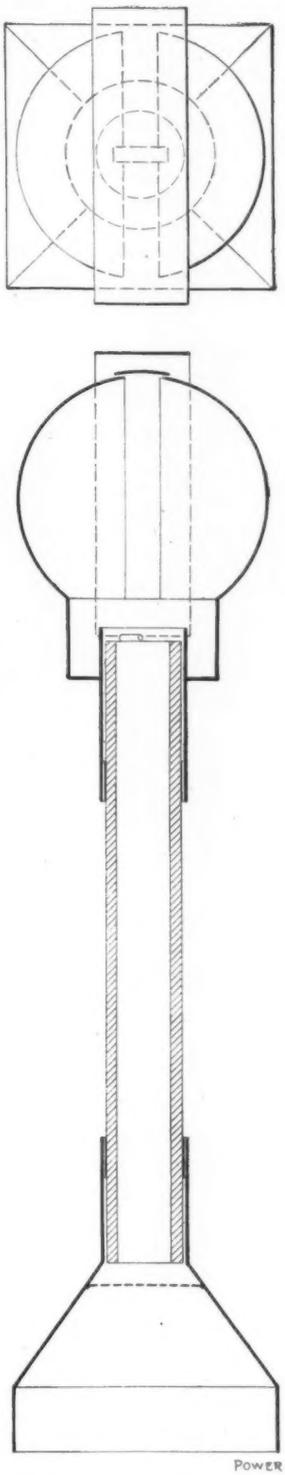


FIG. 2. DETAILS OF CONSTRUCTION

These ventilators can be placed in such position that the wind has full sweep around them, or they may be so located that the wind will come directly down on top of them. Either arrangement will give satisfactory results.

There are only four parts which enter into its construction: the barrel or neck, the diameter of which determines the size of the ventilator; the two hemispherical shells, between which are the vertical outlets and the shield. There are no mechanical parts or movement to get out of order. It is made by the Vacuum Ventilator Company, 84 Purchase street, Boston, Mass.

Solenoid Operated Valve

There is usually considerable difficulty in attempting to start a double-acting compressor because of compression and it is in the function of an unloader that the new solenoid-operated valve recently developed by the Cutler-Hammer Manufacturing Company, of Milwaukee, has found employment. The arrangement consists of a bypass automatically operated by this solenoid valve, which permits the pressure to be released from the compressor cylinder, thereby preventing

SOLENOID-OPERATED VALVE

compression. When the desired speed has been reached the bypass is automatically closed, allowing the loading of the compressor.

It will be noted by referring to the accompanying illustration that the construction is such as to permit placing the solenoid plunger inside the piping system, thus eliminating entirely stuffing-box friction. The energizing of the magnet coil, for which only a small current is required, lifts the solenoid plunger through a short free travel, unseating the valve by a hammer blow. After the valve is started the pressure becomes nearly balanced. The coil circuit can be run wherever desired so that the valve can be operated from any location or series of locations, according to the arrangement.

These devices are also applicable for many functions in hydraulic or pneumatic systems; with self-starters; for remote control of valves used for setting the brakes in a penumatic-brake control sys-

tem, etc. When arranged with a thermostat in a heating system they can be made to automatically control the flow of steam as desired. In signal systems where air-operated whistles are used these valves save piping and enable the ready control from a central location.

Four standard sizes of valves are built: ⅜, ½, ¾ and 1 inch, threaded for standard iron pipe and having an area of opening approximately equal to that of pipe of the same rated size. The solenoid coils used are wound for voltages of 115, 230 and 500, being the standard Nos. 3, 5 and 6 Varley coils.

Boiler Explosion at Augusta, Ga.

By S. Kirlin

A 40-horsepower upright boiler used for pumping out a cofferdam and operating a pile driver on the work being done on the Southern Railway bridge at Augusta, Ga., exploded at about 4:30 a.m. on March 23, instantly killing two negroes and fatally injuring two white men.

The body of one of the negroes was blown to atoms and no part of it has been found. The other one was almost completely blown to pieces, but was found later in the cofferdam. W. A. Vowell, the superintendent of the work, from Columbia, S. C., was badly crushed and scalded and is thought to be fatally injured. D. C. White, night foreman, was scalded all over the body and it is not thought that he can recover. He was standing on the platform on which the boiler was set and was blown over into the cofferdam, from which he was removed shortly after the explosion occurred.

All of the men were working around the boiler at the time and it is said that they were trying to get the injector started. It is supposed that the water was low in the boiler and that the explosion occurred when they succeeded in getting the injector to working. Not a trace of the boiler or engine can be found, so that it is impossible to form any correct idea as to the exact cause of the explosion. It is said that a part of the boiler was blown several hundred feet into the air, passing over the top of the bridge and falling into the river below.

The accident seems to have been very similar to the one with the same type of boiler which exploded in the Ideal laundry at Verona, Penn., a description of which was given in the issue of March 14.

A fire in the plant of the Cohannet Silver Company, Taunton, Mass., on March 22 caused considerable damage in the boiler room. The fire started in another part of the building and caused a total loss of about $45,000.

Peat Society Meeting

The New York section of the American Peat Society held its regular quarterly meeting on Tuesday evening, March 21, at the rooms of the Chemists' Club in West Fifty-fifth street, New York City. Dr. Charles F. McKenna, chairman of the section, introduced Prof. Charles A. Davis, peat expert for the United States Bureau of Mines, who gave one paper entitled, "Late Developments in the Peat Industry" and another, entitled, "Drainage of Peat Deposits."

By way of introduction, Professor Davis spoke briefly of the work of the Bureau of Mines in connection with the development of the peat industry. Up to the present time the work has been largely educational. This has been the result of the lack of facility for accomplishing material progress in experimental work.

In his first paper, the Professor described in outline the various processes of digging and preparing peat that so far have been employed.

In his second paper, he told of the ways in which peat bogs are drained, of the difficulties to be contended with and of the difference in drainage requirements of bogs yielding peat for fuel and those yielding peat for filler and other purposes.

National secretary Julius Bordollo announced that the annual convention of the society would be held in Kalamazoo, Mich., late in September. An interesting program is being prepared.

Steam Pipe Explodes in Amoskeag Mills

On March 27 the blowing out of the "dead end" of a 12-inch steam pipe in the new power plant of the Amoskeag Manufacturing Company, of Manchester, N. H., killed two men and seriously injured seven more, according to reports published in the daily press. Full particulars will be given in an early issue.

PERSONAL

David Moffat Myers, consulting engineer, New York City, has moved to larger offices in the New Whitehall building, 17 Battery place.

George Alfred Goodenough, for many years associate professor of mechanical engineering of the University of Illinois, has been promoted to be professor of thermodynamics.

Bernard L. Walsh, chief engineer for the Woonsocket, R. I., Electric Machine and Power Company, has tendered his resignation. He will be succeeded by Everett Read, of East Bridgewater, Mass.

Cornelius T. Myers, formerly assistant secretary and assistant treasurer of the Wisconsin Engine Company, of Corliss, Wis., has now opened consulting-engineering offices at Racine, Wis.

John B. Perkins, president of the John B. Perkins Company, of Boston, and F. P. Sheldon, M. E., of Providence, left on Saturday, March 25, for a visit to Cuba, Jamaica, Porto Rico and the Bermudas.

Prof. W. F. Schaphorst, of the mechanical-engineering department of the New Mexico College of Mechanic Arts, has resigned his position there to become a technical writer on the staff of A. Eugene Michel, advertising engineer, New York City.

Charles Russ Richards, dean of the college of engineering of the University of Nebraska, has been appointed professor of mechanical engineering in charge of the department at the University of Illinois, effective September 1, 1911. Professor Richards has been identified with the University of Nebraska in various capacities for the past 20 years and has been largely instrumental in organizing and equipping this university for mechanical-engineering study.

George A. Orrok, of the New York Edison Company, visited the University of Wisconsin on March 16 and addressed the student section of the American Society of Mechanical Engineers on the subject of "The Utilization of Blast Furnace Gases, with Especial Reference to Gas Engines." Mr. Orrok dealt with the problem of the blast furnace involving the utilization of its waste gases, and showed the historical development of different means of utilizing these gases. The latter part of the lecture included a brief description of the latest types of blast-furnace gas engines, and was very copiously illustrated by lantern slides.

SOCIETY NOTES

The American Institute of Steam Boiler Inspectors annual meeting and election of officers will be held at the Parker house, Boston, Tuesday, April 25, at 8 p.m.

Under the auspices of the power-transmission section of the National Electric Light Association, a public conference will be held in the United Engineering Societies building, New York City, on Saturday, April 8, to consider the important subject of the relation of the National and State governments to the conservation and utilization of water powers. This subject is one, not only of vital concern to the central-station industry, but affects in many ways the conditions of engineering, the employment of labor and capital, and the welfare of the public. Two sessions will be held, afternoon and evening, and papers and addresses will be delivered by several well known men.

On March 16, the New York Electrical

Society celebrated its three hundredth meeting. F. O. Blackwell lectured on "Hydroelectric Development in Mexico." In opening the lecture, Mr. Blackwell gave an interesting sketch of the causes which have led up to the present conditions in Mexico, giving to the enlightened and progressive policy of President Diaz, the credit for the wonderful developments in hydroelectric installation effected in recent years. The society had a short business meeting, at which reports of committees were received. The treasurer reported that the heavy load of debt which the society had incurred during the last few years, in its endeavor to develop its work and increase the advantages of its membership, has been paid off, and the finances are now in a prosperous condition. Twenty-eight members and thirty-two life members were elected. The society now has over eight hundred members.

NEW PUBLICATIONS

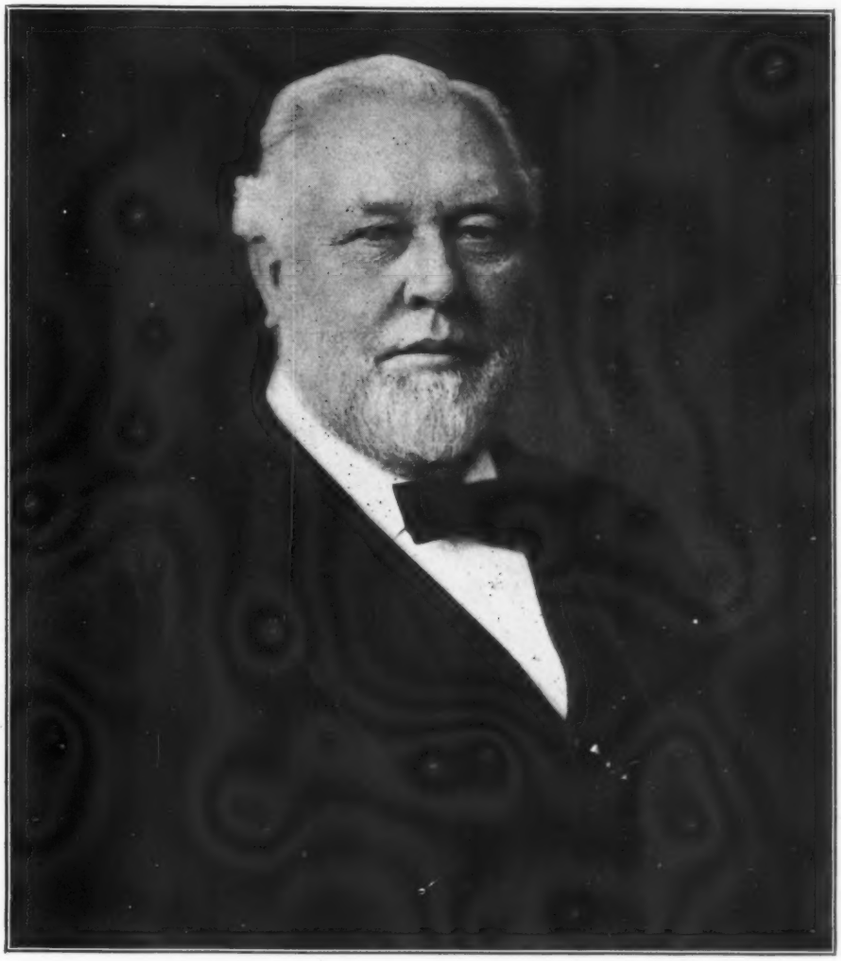
SCIENTIFIC AMERICAN CYCLOPEDIA OF FORMULAS. Compiled and edited by Albert A. Hopkins. Published by Munn & Co., New York City, 1911. Cloth, 1000 pages, 6½x8¾ inches; 200 illustrations. Price, $6.50 net.

This is the latest and probably by far the most complete work of this kind issued. It was compiled by the query editor of the *Scientific American* and contains some 15,000 recipes, formulas and processes selected from a collection of nearly 150,000. There are chapters treating upon soldering, soap and candles, preserving, painting and photography; lapidary art, leather and lubrication; confectionery, glass making and metal working, beverages, alloys and amalgams, beside some hundreds of other topics, many of which are of the odd, out-of-the-ordinary type, relating to little known technical products. A complete index prepared by professional librarians makes it an easy matter to find any subject desired.

"The Strength of Oxyacetlyene Welds in Steel," by Herbert L. Whittemore, has just been issued as Bulletin No. 45 of the engineering experiment station of the University of Illinois. This bulletin gives the results of an extensive series of tests to determine the strength which may be developed in welded joints made by fusing thin steel plates together by means of the flame of an oxyacetylene blowpipe. It was found that with careful manipulation such a welded joint may be expected to have about 85 per cent. of the strength of the plate material. Considerable information as to methods of manipulation of the oxyacetylene blowpipe and the proper regulation of the gases is also given in the bulletin. Copies may be obtained gratis upon application to W. F. M. Goss, director of the engineering experiment station, University of Illinois, Urbana, Ill.

OBITUARY

Charles Wallace Hunt, president of the C. W. Hunt Company, of Staten Island, N. Y., and former president of the American Society of Mechanical Engineers, died at his home on March 27. He was born at Candor, Tioga county, N. Y., in 1841. He studied at Cortland academy, Homer, N. Y., and subsequently received instruction in mechanics and higher mathematics under a private tutor. At the time of the war between the States, he joined the army on the Northern side and served from 1862 to 1865, chiefly in Virginia, undergoing hardships from which his health, for a while, considerably suffered.



THE LATE C. W. HUNT

Entering readily into mechanical pursuits, he engaged, in 1872, in the manufacture of special machinery on Staten Island, N. Y. His plant has since attained great importance in its province—appliances for handling materials in large quantities. There was such novelty in this branch of mechanics when he took it up that his work partook of a pioneer character. The various special devices he put out were designed to meet actual, definite exigencies. The patents of the business run into hundreds and its ramifications extend to conveying and hoisting machinery for ore, coal, etc., cableways, industrial railways, manila rope and kindred lines.

Mr. Hunt was president of the American Society of Mechanical Engineers, 1887 to 1888, having been for several years before that time chairman of its Committee of Publications. He was also a member of many other societies, such as the American Institute of Mining Engineers; New York Electrical Society; Engineers' Club, of New York; National Science Association, and New York Chamber of Commerce. He had been president of the Staten Island Chamber of Commerce and of several manufacturing companies both auxiliary to his main business, the C. W. Hunt Company, and otherwise.

William Carpenter Woodward, for the past 18 years electrical engineer of the Narragansett Electric Lighting Company, of Providence, R. I., died in that city Saturday afternoon, March 25, as a result of cerebral hemorrhage. He had been in poor health since last August

and had not worked since that time. Mr. Woodward gained his first experience in electrical work with the General Electric Company, and later with the Standard Electric Company, of Boston. He had entire charge of the electrical-engineering department of the Narragansett company, and it was he who adapted the high-voltage system now in use in Providence. He was born in Roxbury, Mass., about 50 years ago. A son will be graduated from the Naval Academy at Annapolis this year.

The power equipment of the M. S. Novelty Company's factory in Providence, R. I., was destroyed by fire on March 22. The fire started in some chemicals near the engine room, and Engineer B. T. Edwards barely had time to open the injector and fire doors of the boiler and shut off the gage cocks and get out of the building. The equipment included a 35-horsepower Nagle engine and an upright 35-horsepower boiler.

The boiler room of the Woonsocket, R. I., Dye and Bleaching Company's mill was damaged to the extent of about $500 by a fire on Thursday night, March 9.

NEW INVENTIONS

Printed copies of patents are furnished by the Patent Office at 5c. each. Address the Commissioner of Patents, Washington, D. C.

PRIME MOVERS

POWER GENERATOR. William J. Neilson, Elmhurst, N. Y., assignor to himself, and Leland H. Kimball, Salt Lake City, Utah. 987,158.

CONSTANT-PRESSURE INTERNAL COMBUSTION APPARATUS. Edward P. Noyes, Winchester, Mass. 275,861.

ENGINE. Daniel R. Scholes, Chicago, Ill., assignor to Aermotor Company, Chicago, Ill., a Corporation of Illinois. 987,177.

OIL ENGINE. Hermann Bowyer Leech, Halifax, England. 987,246.

COMPOUND ROTARY ENGINE. Lucas K. Sivertson, Carrington, N. D. 987,264.

ELASTIC-FLUID TURBINE. Berthold Wolff, Berlin, Germany. 987,336.

ROTARY EXPLOSIVE ENGINE. James C. Peterson and Robert T. Peterson, Gleichen, Alberta, Canada. 987,486.

WINDMILL. John O'Toole, Colegrove, Cal. 987,645.

WINDMILL. William P. Bennett, Woodstock, Ohio. 985,131.

POWER WHEEL. Walter H. Fierce, Atlantic City, N. J. 985,152.

ROTARY ENGINE. Stephen E. McGann, Cleveland, Ohio. 985,192.

INTERNAL COMBUSTION ENGINE. Alden E. Osborn, New York, N. Y. 985,198.

INTERNAL COMBUSTION ENGINE. Andrew Betts Brown, London, England, assignor to William Albert Hickman, Pictou, Canada. 985,507.

ROTARY ENGINE. Reece Williams, Albany, Western Australia, Australia. 985,562.

ROTARY ENGINE. David N. Green, Sunbury, Ohio. 985,584.

ROTARY ENGINE. David Newton Green, Sunbury, Ohio. 985,669.

INTERNAL COMBUSTION ENGINE. Henry Joseph Podlesak, Chicago, Ill. 985,703.

BOILERS, FURNACES AND GAS PRODUCERS

MECHANICAL STOKER. Wilfred Rothery Wood, London, England, assignor to the American Stoker Company, Erie, Penn., a Corporation of New York. 987,661.

BLACK-OIL BURNER. James Warren Elder, Visalia, Cal. 987,617.

BOILER. George Peterson, Duluth, Minn. 985,281.

LIQUID-FUEL BURNER. Henry W. Schoff, River Forest, Ill. 985,291.

FURNACE. Henry E. Wallis, Terre Haute, Ind. 985,480.

LIQUID-FUEL BURNER. John Jay Vallier, Oakland, Cal. 985,644.

POWER PLANT AUXILIARIES AND APPLIANCES

FLUE PLUG. Silas Adams, Cleveland, Ohio. 987,099.

COMBINED WATER, VACUUM AND PRESSURE GAGE, AUTOMATIC REGULATOR AND SAFETY DEVICE. William T. Fowden, Chester, Penn. 987,125.

VALVE MECHANISM FOR INTERNAL COMBUSTION ENGINES. Alden E. Osborn, New York, N. Y. 987,164.

STUFFING BOX. John Hahn, Los Angeles, Cal. 987,296.

VALVE. William J. Theis, Chicago, Ill., assignor to Manufacturers Equipment Company, a Corporation of Illinois. 987,334.

STAY BOLT FOR STEAM BOILERS. Patrick J. Connors, Greenville, Penn., assignor of one-half to Frank Disler, Greenville, Penn. 987,431.

BOILER-FLUE CLEANER. William Eichelberger and De Los E. Hibner, Dubois, Penn., assignors to the Vulcan Soot Cleaner Company, of Pittsburg, Penn., Dubois, Penn., a Corporation of New Jersey. 987,450.

VALVE. Edward Dwyer, Clymer, Penn. 987,447.

VALVE. Robert Charles Green, Winchester, England. 987,571.

PRESSURE AND DAMPER REGULATOR. John B. Bischoff, Mount Clemens, Mich. 987,610.

AIR-LIFT DISPLACEMENT PUMP. Frank S. Miller, Indianapolis, Ind. 987,679.

VALVE. Vincent F. Bernesser and Joseph J. Crotty, New York, N. Y. 985,134.

VALVE. Axel Valdemar Clorius, Copenhagen, Denmark. 985,146.

SAFETY VALVE. Nelson Goodyear, New York, N. Y., assignor to Maine Development Corporation, a Corporation of Maine. 985,160.

VALVE. Willard A. Speakman, Wilmington, Del. 985,220.

STEAM TRAP. Joseph B. McKeown, Union Hill, N. J. 985,362.

VALVE. Franklin M. Patterson, Philadelphia, Penn., assignor, by direct and mesne assignments, to Patterson-Allen Engineering Company, a Corporation of New York. 985,444.

VALVE. George W. Hammond, Philadelphia, Penn., assignor of one-half to John H. Michener, Jr., New York, N. Y. 985,526.

PACKING FOR VALVES. Caspar W. Miller, Wallingford, Penn. 985,618.

ELECTRICAL INVENTIONS AND APPLICATIONS

ALTERNATING-CURRENT ELECTROMAGNET. David L. Lindquist, Yonkers, N. Y., assignors to Otis Elevator Company, Jersey City, N. J., a Corporation of New Jersey. 987,146.

ELECTRIC IGNITION SYSTEM FOR EXPLOSION ENGINES. Oliver B. Thompson and Carl R. Moeller, Buffalo, N. Y. 987,188.

ELECTRIC SWITCH. Oliver B. Whipple, Saginaw, Mich. 987,200.

ELECTRICAL SYSTEM OF DISTRIBUTION. Albert S. Hubbard, Belleville, N. J., assignor to Gould Storage Battery Company, a Corporation of New York. 987,301.

ELECTRIC INDUCTION FURNACE. Wilhelm Rodenhauser, Volklingen-on-Saar, Germany, assignor to the Grondal Kjellin Company, Ltd., London, England. 987,404.

ELECTRIC WATER HEATER. Herbert N. Riche and William Ruth Ray, San Francisco, Cal., assignors to Thomas B. Gray, San Francisco, Cal. 987,493.

SNAP SWITCH. Samuel Korf, Chicago, Ill., assignor to the Wi-Ko Electric Company, Chicago, Ill., a Corporation of Illinois. 987,581.

ELECTROLYTIC CELL. Victor E. Goodwin, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. 987,622.

PRIMARY BATTERY. Charles B. Schoenmehl, Waterbury, Conn. 987,647.

TUNGSTEN INCANDESCENT LAMP. John J. O'Brien, Shamokin, Penn. 987,483.

ELECTRIC HEATER AND STERILIZER. Johann G. Wallmann, Oakland, Cal. 987,658.

ENGINEERING SOCIETIES

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Pres., Col. E. D. Meier; sec., Calvin W. Rice, Engineering Societies building, 29 West 39th St., New York. Monthly meetings in New York City. Spring meeting in Pittsburg, May 30 to June 2.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Pres., Dugald C. Jackson; sec., Ralph W. Pope, 33 W. Thirty-ninth St., New York. Meetings monthly.

NATIONAL ELECTRIC LIGHT ASSOCIATION

Pres., Frank W. Frueauff; sec., T. C. Martin, 31 West Thirty-ninth St., New York. Next meeting in New York City, May 29 to June 2.

AMERICAN SOCIETY OF NAVAL ENGINEERS

Pres., Engineer-in-Chief Hutch I. Cone, U. S. N.; sec. and treas., Lieutenant Commander U. T. Holmes, U. S. N., Bureau of Steam Engineering, Navy Department, Washington, D. C.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION

Pres., E. D. Meier, 11 Broadway, New York; sec., J. D. Farasey, cor. 37th St. and Erie Railroad, Cleveland, O. Next meeting to be held September, 1911, in Boston, Mass.

WESTERN SOCIETY OF ENGINEERS

Pres., O. P. Chamberlain; sec., J. H. Warder, 1735 Monadnock Block, Chicago, Ill. Meeting first Wednesday of each month.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA

Pres., Walter Riddle; sec., E. K. Hiles, Oliver building, Pittsburg, Penn. Meetings 1st and 3d Tuesdays.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Pres., R. P. Bolton; sec., W. W. Macon, 29 West Thirty-ninth street, New York City.

NATIONAL ASSOCIATION OF STATIONARY ENGINEERS

Pres., Carl S. Pearse, Denver, Colo.; sec., F. W. Raven, 325 Dearborn street, Chicago, Ill. Next convention, Cincinnati, Ohio, September 12-15, 1911.

AMERICAN ORDER OF STEAM ENGINEERS

Supr. Chief Engr., Frederick Markoe, Philadelphia, Pa.; Supr. Cor. Engr., William S. Wetzler, 753 N. Forty-fourth St., Philadelphia, Pa. Next meeting at Philadelphia, June 5-10, 1911.

NATIONAL MARINE ENGINEERS BENEFICIAL ASSOCIATIONS

Pres., William F. Yates, New York, N. Y.; sec., George A. Grubb, 1040 Dakin street, Chicago, Ill. Next meeting at Detroit, Mich., January 15-19, 1912.

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.

Pres., Arthur J. Frith; sec., Charles Kratsch, 416 W. Indiana St., Chicago. Meetings the second Friday in each month at Fraternity Halls, Chicago.

UNIVERSAL CRAFTSMEN COUNCIL OF ENGINEERS

Grand Worthy Chief, John Cope; sec., J. U. Bunce, Hotel Statler, Buffalo, N. Y. Next annual meeting in Philadelphia, Penn., week commencing Monday, August 7, 1911.

OHIO SOCIETY OF MECHANICAL ELECTRICAL AND STEAM ENGINEERS

Pres., O. F. Rabbe; acting sec., Charles P. Crowe, Ohio State University, Columbus, Ohio. Next meeting, Youngstown, Ohio, May 18 and 19, 1911.

INTERNATIONAL MASTER BOILER MAKERS' ASSOCIATION

Pres., A. N. Lucas; sec., Harry D. Vaught, 95 Liberty street, New York. Next meeting at Omaha, Neb., May 23-26, 1911.

INTERNATIONAL UNION OF STEAM ENGINEERS

Pres., Matt. Comerford; sec., J. G. Hannahan, Chicago, Ill. Next meeting at St. Paul, Minn., September, 1911.

NATIONAL DISTRICT HEATING ASSOCIATION

Pres., G. W. Wright, Baltimore, Md.; sec. and treas., D. L. Gaskill, Greenville, O.

Moments with the Ad. Editor

A department for subscribers edited by the advertising service department of Power

THE other day a representative of a Calgary, Alberta, distributing company came into our office to renew old acquaintances.

In talking of his work, he said, "My job is to go out into Western Canadian towns and establish branches of my firm for the distributing of all kinds of agricultural machinery—plows, harvesters, gasoline and steam engines, traction engines, windmills, etc. I have found that such branches invariably succeed if there is a daily or even a weekly paper in the town—if there isn't we can't do business."

"Why is that?" we asked.

"Well," he replied, "you see the possible customers of any one of our branch stores are very widely scattered—they may live at a distance of from thirty to forty miles from the town—and it would be impossible to cover the territory economically with traveling salesmen. The only way we can tell them about our store and its stock is through the columns of the local paper. So, if there isn't such a thing in the town, we pass it by."

"Then you are believers in advertising, in Western Canada?" we asked.

"Oh, well, we don't really advertise," he replied, "we just buy space in the paper and then tell in it what we have to sell, why the farmers need our goods, how they can increase their crops with modern machinery and methods, and all that sort of thing. Of course, we have to tell them the plain truth and back it up with the goods—that's all we try to do. We don't know how to do real advertising yet."

And he meant it.

He didn't realize that his firm out there in a big, new country had discovered and acted upon some of the realest, most fundamental principles known to "advertising experts."

They had learned that they must have a medium that would draw their widely scattered customers together to hear their story—

That if there were such a medium the thirty or forty miles of distance made no difference.

And they had learned that if they had articles to sell that were valuable to the customer, they could interest him and bring him to the buying point by simply telling him the truth and backing up every statement with the goods themselves.

Could there possibly be a better example of the *humanity* of advertising?

Finally we said to our visitor, "How did it happen that you adopted this method of telling your advertising story?"

"Well," he said, "out there we are rougher in our methods than you are in the East. If Jim Jones advertised that he sold harvesters that would thresh 500 bushels a day and someone bought one and found that it couldn't turn out more than 300 bushels—well, it wouldn't be long before Jim would decide that he needed a change of climate."

And this is, perhaps, one difference between advertising principle in the "woolly West" and the effete East.

Out there a man may tell the truth in his ads because he is afraid not to—

Which is a negative reason.

Here the advertiser works positively. He tells the truth because it means business to him, and any business man who became a "Jim Jones" would soon have to seek, not another climate or residence, but another business.

Our conversation with the man from Canada proved to us again that the necessity, the method, the rules and the ethics of advertising are pretty much the same all over the world.

And, further, it proved the tremendous effect advertising has on the development of industry.

As he said, "It is the advertising in our Western papers that makes the country grow so fast that you Easterners think we are lying when we tell you our figures on increased population and production. Give us a medium that covers any given section—let us tell our story to the readers, and we will soon have most of them using modern implements and getting increased production. Then all we ask is enough freight cars to move the crops on time and, before long, our farmers will be reading the automobile ads!"

BUSINESS ITEMS

G. L. Simonds & Co., sales agents for the Vulcan soot cleaner, have removed their offices to 801 Steinway building, Chicago, Ill. On account of their growing business they were compelled to seek larger and better quarters.

The Foos Gas Engine Company, Springfield, Ohio, has shipped two engines to the Government to be used in operating one of the dams in the river-improvement work, near Wheeling. They are of the vertical three-cylinder type of 100 horsepower each.

The Parker Boiler Company, of Philadelphia, Penn., has recently installed a few of its downflow boilers in some far-away places, including one 122-horsepower in Honolulu, one 372-horsepower in Jerome, Ariz., one 137-horsepower in Coalinga, Cal., and two 207-horsepower in Pueblo, Colo., court house.

The Ohio Blower Company, Cleveland, Ohio, reports recent sales of 14 steam separators. Among the purchasers are Farmers Feed Company, New York, N. Y.; Cadillac Manufacturing Company, Cadillac, Mich.; Pritchard Stamping Company, Rochester, N. Y.; Ohio Quarries Company, Amherst, Ohio, and the Fitzsimmons Company, Youngstown, Ohio.

The Minneapolis downtown office of the Minneapolis Steel and Machinery Company, has been moved from the Corn Exchange, where it was located for several years, to 914 Flour Exchange. The mechanical department of the company is represented in this office by F. J. Rose, and the structural department by Daniel Agnew. The Butte office has recently been changed to 319 Electric building, Butte, Mont. The Denver office has been changed to 902 Gas and Electric building, Denver, Colo. At El Paso, Texas, the office of the structural department was discontinued this winter, and a San Francisco agency established with the firm of Braun, Williams & Russell. A branch is also in operation now at Spokane, Wash., 225 Paulson building, in addition to the Seattle branch. The branches at Seattle, Spokane, Butte and Denver are now primarily devoted to the work of the structural department, while the Omaha branch, the Dallas, Texas, office, the San Francisco and Los Angeles branches devote their principal energies to the mechanical department.

NEW EQUIPMENT

E. C. Carr, Colton, Cal., will equip a cold-storage plant.

Sterling, Mass., will build a municipal electric-light plant.

Rockland, Mass., will build a municipal electric-light plant.

The Grant Yarn Mill, Fitchburg, Mass., is to erect an addition.

Harrison, Mich., is planning the erection of a waterworks system.

J. George Smith, St. Paul, Minn., will erect a $10,000 candy factory.

Sparta, Ga., will construct waterworks. John D. Walker, mayor.

Ashtabula, Ohio, will double the capacity of its electric-light plant.

Wel'and, Ont., will buy turbine engines and equipment for waterworks.

Wilcox, Ariz., is contemplating the erection of an electric power plant.

Douglas, Ariz., is considering the erection of an electric power plant.

Gresham, Ore., will install a new waterworks and sewerage system.

The Scranton (Penn.) Lace Company will build a four-story addition.

The Newton (N. J.) Gas and Electric Company will erect an addition.

John and Burt Marples, Milton, Ind., will establish an ice-making plant.

The Colonial Ice Company, Salem, Ohio, will erect an ice-making plant.

Ludlow, Mass., will make improvements in its municipal electric-light plant.

South Framingham, Mass., is considering installing an electric-light plant.

The Chino (Cal.) Domestic Water Company will rebuild its water system.

The Gandy Belting Company, Baltimore, Md., will erect a five-story addition.

Car & Brown, Hamilton, Ohio, are rebuilding their flour mill, recently burned.

The American Woolen Mill Company will erect another mill at Enfield, N. H.

The city of Chelsea, Mass., will install a steam boiler in the Williams school.

The Virginia Brew Company will erect a cold-storage plant at Chisholm, Minn.

Northampton, Mass., contemplates installing a municipal electric-lighting plant.

The C. Turnbull Knitting Company, Galt, Ont., will erect a four-story addition.

Packing plant of Christopher F. Kurrie, Baltimore, Md., was destroyed by fire.

The Dun Worsted Mills will build an addition to its plant at Woonsocket, R. I.

The Malden (Mass.) Electric Company will erect an addition to its power plant.

The Massachusetts Sand Brick Company, West Oxford, Mass., will install a boiler.

The Salts Manufacturing Company, Bridgeport, Conn., will install four new boilers.

The San Francisco (Cal.) Gas and Electric Company will erect a new building.

Battleford, Sask., will spend $100,000 for waterworks pumping and other equipment.

The Lebanon (N. H.) Electric Light Company contemplates installing a new engine.

The Maryland Coal and Iron Company, Barrelsville, Md., will erect a power plant.

Plans are being prepared for a municipal electric-lighting plant at Baker City, Ore.

The Salem (Ore.) Brewing Company will erect a new plant at Klamath Falls, Ore.

The Peck, Stow & Wilcox Company, Southington, Conn., will erect a new power plant.

The Winchendon (Mass.) Electric Light and Power Company will double its capacity.

The New Hampshire Artistic Web Company, Barnstead, N. H., will install a boiler.

Benjamin Cunha, Half Moon Bay, Cal., is planning to install an electric-lighting plant.

The Amoskeag Mills, Manchester, N. H., will install a 5000-kilowatt turbine generator set.

A bill has been passed for boiler equipment for the Whittier State School, Whittier, Cal.

The cold-storage and ice plant of Conover Gaskin, Long Branch, N. J., was destroyed by fire.

The Lovel & Covel Company, Boston, Mass., is in the market for a 50-horsepower gas engine.

An electric-generating plant will be installed at the State Hospital, Poughkeepsie, N. Y.

The Phœnix Railway Company, Phœnix, Ariz., will build a new substation at Orangewood.

The Balfour-Guthrie Company, Portland, Ore., will erect a boiler-room addition to its plant.

The Somerset (Penn.) Water Company will erect a new pumping station to cost $25,000.

The Holt Ice and Cold Storage Company, Indianapolis, Ind., will build an addition to its plant.

Marcus, Wash., is planning to install a new water supply system and build a lighting plant.

The Mobridge (S. D.) Electric Light, Power and Heat Company has been granted a franchise.

Clarksville, Tenn., has had plans drawn for new waterworks plant and will soon receive bids.

The United Food Products Company, Chicago, Ill., will erect a six-story building on Erie street.

The United Electric Light Company, Springfield, Mass., will make extensive improvements.

Oglethorpe, Ga., will vote on issuance of $18,000 bonds for electric-light plant and waterworks.

The Housatonic Power Company will increase equipment at its plant in South Norwalk, Conn.

The Oil Well Supply Company, Pittsburg, Penn., is in the market for feed-water heater and purifier.

Benton Harbor, Mich., will vote on the proposition of issuing $100,000 bonds for water plant.

The Mount Hood Railway and Power Company, Portland, Ore., will erect a $100,000 power plant.

The Continental Sugar Company will erect a $750,000 plant at West Park, a suburb of Findlay, Ohio.

The Beverly (Mass.) Gas and Electric Company will install generator set, boilers and accessories.

The Bell Telephone Company will build a new exchange at Broadway and Greenwood street, Toledo, Ohio.

Fire destroyed the plant of the Washington (Ill.) Electric Light and Power Company. Loss, $50,000.

The Y. M. C. A., Montreal, Canada, will erect a new power house next to its new building to cost $15,500.

W. W. Brison, San Bernardino, Cal., will double the capacity of his ice and electric plants at Barstow, Cal.

Marquette, Mich., will vote on the issuance of $1,000,000 bonds for extending the water and electric plants.

The board of public works, St. Louis, Mo., will install an electric-light plant in the basement of the city hall to cost $70,000.

The Connecticut Valley Street Railway, Greenfield, Mass., is in the market for a 500-kilowatt rotary for its power house.

The Wm. Edwards Company, Cleveland, Ohio, will require two 150-kilowatt and one 75-kilowatt generators for a new warehouse.

The plant of the Harrisburg (Ark.) Electric Light and Power Company has been purchased by Morris Hayutin, who will improve same.

The Miami Power Company, recently organized, will erect a $500,000 hydro-electrical power plant at Woodstock, Ohio, on the site of the old paper mill.

Lee Brothers & Co., Athol, Mass., shoe manufacturers, will change from steam to electric power. Will install two turbines of about 100 horsepower each.

Bids will be received up to April 17, by the board of supervisors, Los Angeles, Cal., for two engine-generator sets in the Hall of Records. Plans by Hudson & Munsell, Los Angeles.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids April 11, for ten mechanical stokers for the navy yard at Washington, D. C., as per Circular No. 3417.

The State legislature, at Pendleton, Ore., has passed a bill for appropriations for the State insane asylum as follows: $25,000 for power plant, $30,000 for waterworks and sewerage, $50,000 for heating plant, $25,000 for automatic sprinkler system. State architect, Portland.

HELP WANTED

Advertisements under this head are inserted for 25 cents per line. About six words make a line.

ENGINEERS WANTED to solicit for the Rolin patent adjustable grate. Apply Standard Grate Co., Heed Bldg., Philadelphia.

WANTED—Thoroughly competent steam specialty salesman; one that can sell high-grade goods. Address "M. M. Co.," POWER.

AN ENGINEER in each town to sell the best rocking grate for steam boilers. Write Martin Grate Co., 281 Dearborn Street, Chicago.

AGENTS WANTED for first-class steam specialty in use throughout United States. Address C. S. Wood, 410 S. 15th St., Philadelphia, Penn.

WANTED—An engineer in each city as agent for a high class water-back Scotch boiler, the most economical steam generator known to the trade. Kingsford Foundry & Machine Works, Oswego, N. Y.

WANTED—A competent man to do general inspection work for a liability insurance company; must be qualified to assist and instruct other inspectors; expert knowledge of elevators required. Address, stating experience, education, age and whether married or single, Box 399, POWER.

WANTED—Engineer to take charge of 50 kilowatt producer gas plant for electric lighting; applicant must be familiar with Westinghouse gas engines and producers; state age, experience and salary desired; climate very good; living expenses about six dollars a week. Address Arsuaga & Co., Ltd., Box 41, Manati, Porto Rico.

MECHANICAL ENGINEER for position that requires a theoretical and practical knowledge of heating, plumbing and sprinkler systems; would prefer a technically trained man; a position with good prospects; answer, giving details as to education, past experience and connection, to Dept. 1056, Western Electric Company, Chicago.

SITUATIONS WANTED

Advertisements under this head are inserted for 25 cents per line. About six words make a line.

Position wanted as gas engineer; can give reference; five years' experience. Box 413, POWER.

CHIEF ENGINEER, thoroughly competent in operating and construction of power plants, will be open for engagement April 22; best of references. Box 311, POWER.

STEAM ENGINEER and blast furnace master mechanic desires to locate with construction or repair department, erecting steam plants and general machinery, or maintaining same. Box 407, POWER.

STEAM TRAPS AND PACKINGS—Substantial commission offered to a thoroughly competent salesman calling regularly on architects and building contractors to handle best and cheapest steam trap and a complete line of imported steam packing. Apply "Energy," Care POWER.

MISCELLANEOUS

Advertisements under this head are inserted for 25 cents per line. About six words make a line.

PATENTS. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 904 G St., Washington, D. C. Write for Inventor's Handbook.

PATENTS—IDEAS WANTED — Manufacturers want Owen patents. Send for three free books. R. B. Owen, Dept. 43, Washington, D. C.

AN EXPERIENCED SALESMAN desires to take on a side line of approved steam specialties for the Pittsburg district. Address Box 406, POWER.

WANTED TO EXCHANGE, an 8x10 steam jacketed slide valve horizontal Nagle engine, without flywheel, for a small engine lathe. Write Box 215, Fitzwilliam Depot, N. H.

PATENTS—H. W. T. Jenner, patent attorney and mechanical expert, 608 F St., Washington, D. C. I make investigations and report if patent can be had and exact cost.

WANTED—Management of New England branch office for a few high-grade steam specialty houses wishing to promote their business in this territory. Address "R. H. L.," POWER.

ELECTRICAL ENGINEERING—We guarantee to give a thorough tuition in electrical engineering for $10 only; fees returned if not satisfied. Write us before paying more. Box 811, Cincinnati, O.

A WELL KNOWN and reliable concern in Hungary, with ample capital, wishes to represent American builders of oil and gas engines (producer gas) and other machines. Address Box 401, POWER.

SUBSCRIBE NOW for the 1911 issue of the Stationary Engineers' Directory of the city of Philadelphia; $5 per copy. Mail checks to Stationary Engineers' Club, 1108 Arch street, Philadelphia, Penn.

REPRESENTATION—An established sales agency handling power plant equipment for Pittsburg district wishes to add open feed water heaters, steam and oil separators and traps. Address Box 404, POWER.

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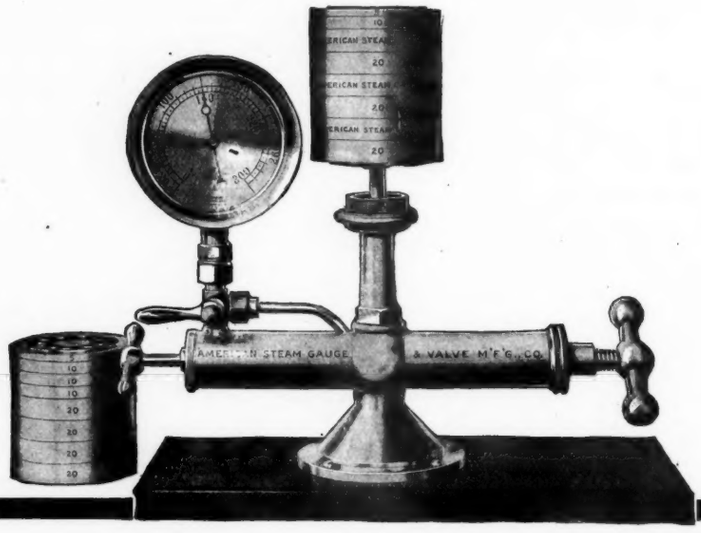

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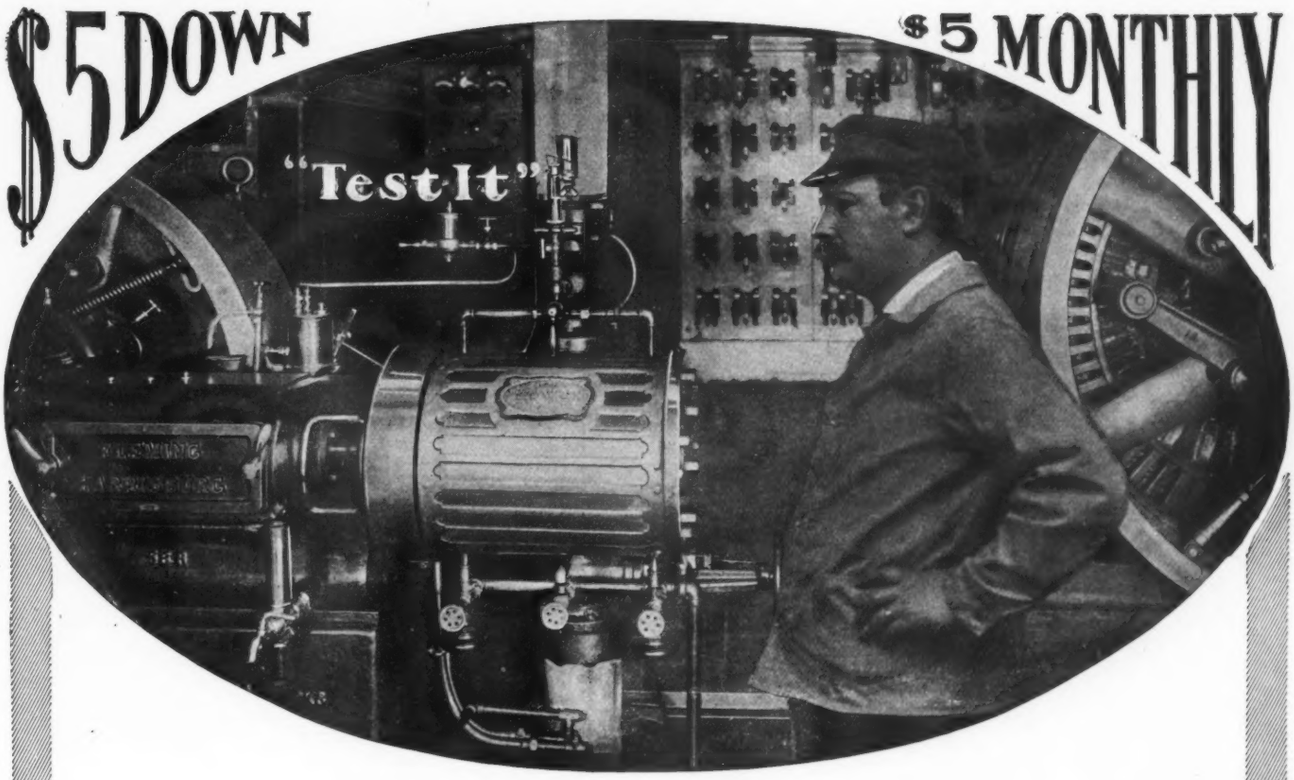

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